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CHAPTER 2: ALTERNATIVES

Introduction

The National Environmental Policy Act of 1969 (NEPA) prescribes that federal managers make their decisions with regard to major federal actions in a logical and informed manner. Managers should consider a reasonable range of alternatives, and managers should reflect upon the consequences of each alternative, including the one proposed for implementation, as well as the alternative of taking no action. NEPA and USFWS policy require the development of alternatives taking into account the issues and concerns of stakeholders, interest groups, and the public in general. In an effort to acquire public input, the USFWS has engaged in workshops and public meetings to allow for the maximum personal access to the process by the public during the scoping process. Alternatives are derived only after there has been careful consideration of public and stakeholder comments obtained in the scoping process. The alternatives must meet the purposes of the Federal proposal, meet the goals of the refuges, and comply with the missions of the Refuge System and the USFWS. NEPA also requires that the alternatives include the alternative of “No Action” and rigorously explore and objectively evaluate a reasonable range of alternatives.

The USFWS is considering two separate, but related federal actions and purposes within this EIS. The first proposes the development of a Comprehensive Conservation Plan (CCP) for each of the refuges in the Refuge Complex, and the second proposes the expansion of the refuge boundary for each of the refuges in the Refuge Complex. The proposed refuge boundary expansions are described and detailed in a Land Protection Plan (LPP). To more accurately inform the public and to better facilitate analysis of the impacts, the USFWS has developed two separate sets of alternatives, with each set addressing one of the two Federal actions. There is a set of “Refuge Management Alternatives” addressing the development of a CCP for each refuge, and there is a set of “Refuge Boundary Expansion Alternatives” addressing the expansion of each refuge’s boundary. Each set contains the appropriate “No Action” alternative, explores and evaluates a reasonable range of alternatives to the proposed action, and identifies a “Preferred Alternative” to be implemented.

Conservation priorities for North American avian species and recommendations for habitat protection, management, and restoration in support of conservation of these species have been developed and identified recently through several international, national, and regional avian conservation plans. These plans include the North American Waterfowl Management Plan (NAWMP), the U.S. Shorebird Conservation Plan, the North American Waterbird Conservation Plan, and the Partners in Flight Landbird Conservation Plan. At a regional level, several step-down plans have been developed to guide conservation efforts at a more local scale. Examples applicable to avian conservation on the Refuge Complex and the project area as a whole include the Gulf Coast Joint Venture Chenier Plain Initiative Area Plan (Esslinger and Wilson 2001), the Gulf Coast Joint Venture Mottled Duck Conservation Plan under the North American Waterfowl Management Plan (Wilson 2005), and the Lower Mississippi/Western Gulf Coast Region Plan (Elliot and McKnight 2000) under the U.S. Shorebird Conservation Plan. A shared outcome of these avian conservation planning efforts has been identification of the need for “All Bird Conservation”, i.e., addressing species and habitat conservation and management priorities across all avian species guilds. Conservation priorities identified in these international, national, and regional plans have been stepped-down and incorporated in both the Refuge Management and the Refuge Boundary Expansion alternatives in this EIS/CCP/LPP.

In 2005, the USFWS published a national list of “Avian Species of Conservation Concern (USFWS 2005). Thirty-seven of the 48 Avian Species of Conservation Concern listed by the USFWS for the Gulf Coastal Prairie Bird Conservation Region (BCR) occur on the Refuge Complex and within wetland, prairie, and woodland habitats in areas identified in the Refuge Boundary Expansion Alternatives.

Wetland-dependent Avian Species of Conservation Concern occurring on the Refuge Complex and areas identified in the Refuge Boundary Expansion Alternatives include Yellow and Black rails, American Bittern, White Ibis, Hudsonian Godwit, Long-billed Curlew, Short-billed Dowitcher, Least Tern, Seaside

Sparrow, and Sprague's Pipit. Avian Species of Conservation Concern utilizing prairie grassland habitats on the Refuge Complex and areas identified in the Refuge Boundary Expansion Alternatives include LeConte's Sparrow, Nelson's Sharp-tailed Sparrow, Henslow's Sparrow, Buff-breasted Sandpiper, Sedge Wren, Loggerhead Shrike, and White-tailed Hawk. Neo-tropical migrant landbirds listed as Species of Conservation Concern which utilize woodland habitats on the Refuge Complex and areas identified in the Refuge Boundary Expansion Alternatives include Swainson's Warbler, Prothonotary Warbler, Kentucky Warbler and Swallow-tailed Kite.

Wetland habitats within the project area and on the Refuge Complex provide important wintering and migrational habitat for many species of Central Flyway waterfowl, including several species whose continental populations are below goals established under the North American Waterfowl Management Plan and/or listed by the USFWS as Game Birds Below Desired Condition (USFWS 2004). These species include Northern Pintail, Lesser Scaup, and Ring-necked Duck. The Mottled Duck is a year-round resident of Gulf Coast, and conservation and management of this species is a major goal of the NAWMP's Gulf Coast Joint Venture (GCJV) Chenier Plain Initiative Plan (Esslinger and Wilson 2001). Steep declines in Mottled Duck numbers on coastal national wildlife refuges in Texas have been documented in recent years (USFWS, Division of Migratory Birds unpublished reports), and this species is considered to be Rare and Declining in the Coastal Prairies Region of Texas (Shackleford and Lockwood 2000). Coastal marsh, coastal prairie and agricultural habitats within Chambers, Jefferson and Orange counties, including the Refuge Complex historically supported the highest densities of breeding Mottled Ducks in Texas (Stutzenbaker 1988), and continue to be critically important to the long-term conservation of this species. Meeting the waterfowl population objectives established by the GCJV Chenier Plain Initiative Plan requires several habitat protection, management and restoration actions for coastal marshes and enhancement of agricultural habitats to increase their value to waterfowl (Esslinger and Wilson 2001). These include several strategies for reducing marsh loss (conversion to open water) and restoring already degraded marshes, prescribed burning, controlled grazing, exotic/invasive species control, additional habitat protection through land acquisition and cooperative agreements, and increased technical assistance for waterfowl habitat enhancement on private lands.

The project area and the Refuge Complex lie within the Gulf Coast Prairie (GCP) Region under the U.S. Shorebird Conservation Plan (USSCP). Thirty-nine shorebird species occur in this Region, and it is considered to be of "extremely high importance" to 14 species and of "considerable importance" for 21 additional species. Of these 35 species, 17 are considered to be species of conservation concern under the USSCP. Four are considered "Highly Imperiled" – Snowy Plover, Piping Plover, Long-billed Curlew, and Eskimo Curlew (believed extirpated). Thirteen species are considered "Species of High Concern:" American Golden Plover, Wilson's Plover, Mountain Plover, American Oystercatcher, Whimbrel, Hudsonian Godwit, Marbled Godwit, Ruddy Turnstone, Red Knot, Sanderling, Buff-breasted Sandpiper, American Woodcock, and Wilson's Phalarope. Wetland habitats within the Refuge Complex provide important migrational and wintering habitat for many of the shorebird species identified as needing conservation attention within the GCP Region, including for three of the "Highly Imperiled" species: Piping Plover, Long-billed Curlew, and Snowy Plover, and for ten "Species of High Concern": American Golden Plover, Whimbrel, Hudsonian Godwit, Marbled Godwit, Ruddy Turnstone, Red Knot, Sanderling, Buff-breasted Sandpiper, American Woodcock, and Wilson's Phalarope. The GCP Region Shorebird Plan recommends several management actions for maritime and non-maritime shorebirds including increased protection and enhanced management of beach nesting areas, additional habitat protection through land acquisition, restoration of beach and barrier island habitat, incorporation of shorebird conservation into U.S. Army Corps of Engineers projects, addressing freshwater inflow needs of estuaries as part of water resources planning and development, expansion and enhancement of exotic/invasive species management efforts (Chinese tallow), continued use of prescribed burning to enhance shorebird habitat in wetland and prairie habitats, and expanded and enhanced management of rice agriculture, crawfish impoundments, and moist soil units to benefit shorebirds. Standardization and coordination of systematic population monitoring of priority shorebird species is also recommended.

The North American Waterbird Conservation Plan (Kushlan *et al.* 2002) classified colonial and semi-colonial breeding water bird species into one of several "at risk" categories, including "not currently at risk", "low", "moderate", "high", "highly imperiled", and identified those species for which there is

“insufficient information available to assess risk”. Wetland habitats within the project area on the Refuge Complex provide important wintering, migrational and/or nesting habitat for 14 colonial and semi-colonial water bird species deemed at moderate risk, and 6 species deemed at high risk. High risk species include Tri-colored Heron, Little Blue Heron, Snowy Egret, Least Tern (all four nest on the Refuge Complex), Wood Stork, and Gull-billed Tern. The population status of solitary breeding marsh birds will be assessed in the second version of the NAWCP. The lands within the Refuge Complex are extremely important for many of these species, including several already identified by the USFWS as Species of Conservation Concern. These include Yellow Rail, Black Rail, and American Bittern. For the Southeast U.S. Region, the NAWCP identifies major concerns or threats to waterbirds to be fisheries “by-catch”, loss and deterioration of habitat, disturbance of nesting areas (particularly to beach-nesting terns and skimmers), and effects from contaminants. Standardization and coordination of systematic population monitoring of priority water bird species is also recommended.

The Partners in Flight (PIF) Conservation Program is an international, multi-agency and multi-organization conservation initiative for North American landbirds and waterbirds. PIF recently completed an assessment of the status and conservation needs of all North American land and waterbirds. This assessment included consideration of population trends, habitat trends, and threats on breeding and wintering grounds. National, regional, and more local conservation priorities were determined. These species represent conservation priorities for the USFWS and other PIF partners including state wildlife agencies, the U.S. Forest Service, and other governmental and private partners. Multi-agency PIF conservation strategies for Texas are currently under development, and these strategies will guide management activities at the local and regional scale. In Texas, the PIF partners have identified priority species for conservation, monitoring and management in relation to specific habitat types and seasons within the Texas Coastal Prairies region (Texas Parks and Wildlife Department 2000), which includes the Refuge Complex. Habitats on the Refuge Complex provide wintering, migrational and/or nesting habitat for 16 species of wetland-associated birds, 10 species of grassland birds, and 13 species utilizing woodland habitats which are listed as Rare and Declining within the Texas Coastal Prairies Region. Currently, the Gulf Coast Bird Observatory in Lake Jackson, Texas, in partnership with the Gulf Coast Joint Venture, is preparing the PIF Landbird Conservation Plan for the Gulf Coastal Prairies (Bird Conservation Region 37) which includes project area and Refuge Complex.

PART A: REFUGE MANAGEMENT ALTERNATIVES

The first of the two separate, but related, proposals addressed in this EIS is the development of a Comprehensive Conservation Plan (CCP) for the Refuge Complex. The Comprehensive Conservation Plan provides a framework for future management of the Moody, Anahuac, McFaddin and Texas Point NWRs. The CCP is designed to serve as a vision for the Refuge Complex and provide management guidance through maintenance, restoration, and use of Refuge resources during the next 15 years. The environmental analysis of this plan is addressed at the conceptual and programmatic level. While it contains some relative analytical specificity, it is not intended to be a detailed site plan with exact locations for facilities or precise descriptions of programs. Overall, there is a need to make the management of each refuge consistent with the National Wildlife Refuge System mission, goals, and policies. The USFWS' CCP policy encourages managers and planners to develop alternatives in order to arrive at the best decision possible on behalf of the American public as well as the overall mission of the Refuge System. All of the alternatives will accomplish, in different ways and with different perspectives, the Refuge Goals that define the responsibilities of the refuge staff as they relate to achievement of the purposes for which the refuge was established and the overall mission of the Refuge System. Also, some Refuge Goals relate to the USFWS' responsibilities toward compliance with a number of federal statutes such as the Endangered Species Act, the National Historic Preservation Act, the Antiquities Act, and the Clean Water Act, among others.

Since the USFWS is conducting an ongoing action and is considering developing new management plans, the "No Action" alternative is the continuance of current management activities and programs on the Refuge Complex under existing management plans. Four additional refuge management alternatives were developed, considering refuge establishment purposes for the conservation and management of migratory birds, the mission of the Refuge System, and the major issues developed during public and internal scoping.

The Refuge System Improvement Act states that a CCP for each refuge is needed to address "...significant problems that may adversely affect the populations and habitats of fish, wildlife and plants and the actions necessary to correct or mitigate such problems." Specifically, these problems at this Refuge Complex include the need to ensure biological integrity and maintain biological diversity and environmental health by reducing saltwater intrusion and restoring freshwater and sediment inflows to marshes and littoral systems, restoring altered wetland systems, restoring degraded prairie and woodland habitats, protecting unique and rare habitats and fish and wildlife species, controlling exotic and invasive species, reducing threats from contaminants and considering and addressing the future impacts of relative sea level rise. Development of the refuge management alternatives considered addressing these problems and issues.

The Refuge System Improvement Act also directs the USFWS to facilitate compatible wildlife-dependent recreational uses on national wildlife refuges. Through the refuge management alternatives, the six priority wildlife-dependent uses occurring on Refuge Complex are evaluated (hunting, fishing, wildlife observation and photography, and environmental education and interpretation), as are strategies to better manage them and/or provide additional opportunities for these uses to occur.

The Refuge System Improvement Act also directed that the Secretary of the Interior in administering the Refuge System will, in preparing each Comprehensive Conservation Plan, consult with adjoining Federal, State, local, and private landowners and affected State conservation agencies. Consistent with the Refuge System Improvement Act, the USFWS expressed in Director's Order No. 148 recognition that the various State game and fish organizations have a unique role in the planning and decision making process for CCPs; and, provided for State fish and wildlife agency representation on the CCP planning teams. Representatives of Texas Parks and Wildlife Department (TPWD) have been involved from the very start of the planning process for this EIS. A designated TPWD representative has participated as a member of the Core Planning Team in the scoping and alternative development stages of this EIS. Preliminary drafts of both sets of alternatives were presented for discussion and comment at the TPWD offices in Austin, Texas.

Summary of Refuge Management Alternatives

The five Refuge Management Alternatives (A - E) are listed below with a short summary for each.

Refuge Management Alternative A: (NEPA No Action Alternative) Continuation of Current Management

Under this Alternative, current management programs on the Refuge Complex would continue unchanged. Management of wetland habitats including coastal marsh and prairie wetlands to benefit waterfowl, shorebirds, wading birds, and other wetland-dependent migratory birds would continue at current levels and intensities using prescribed burning, grazing, water level and salinity management, rice farming, moist soil management, and mowing and haying. Restoration and protection of native habitats including wetlands, prairie and woodlands would proceed at current annual acreage rates and using existing techniques. The Refuge Complex would continue to provide opportunities for all six of the Refuge System's priority wildlife-dependent recreational uses, including hunting, fishing, wildlife observation and photography, and environmental education and interpretation through the use of existing programs and facilities.

Refuge Management Alternative B: Emphasis on Intensifying Management of Wetland Habitats for Waterfowl, Shorebirds, Wading Birds, and Other Wetland-Dependent Migratory Birds

Under this Alternative, the Refuge Complex would focus its management efforts on active management of wetland and upland habitats to benefit waterfowl, shorebirds, wading birds, and other wetland-dependent migratory and resident birds. In marsh habitats, grazing intensity, annual prescribed burn acreage and the frequency of burning would be increased to substantially increase the amount of marsh habitat in early successional plant communities. Two new marsh semi-impoundments totaling 7,500 acres would be constructed and water management capabilities enhanced in existing impoundments through installation of new control structures and levees. The cooperative rice farming program, moist soil management, and haying and mowing programs on Anahuac NWR would be expanded to enhance shallow fresh water wetland habitats and adjacent upland prairies for resident Mottled Ducks, and for wintering and migrating waterfowl shorebirds and wading birds. The Refuge Complex would also continue to provide and promote opportunities for all six of the National Wildlife Refuge System's priority wildlife-dependent recreational uses, with an emphasis on providing more public hunting opportunities.

Refuge Management Alternative C: Emphasis on Native Habitat Restoration and Addressing Major Threats to the Ecosystem

Under this Alternative, the Refuge Complex would focus its management efforts on restoring wetlands, native prairie and woodlots, and on reversing trends of loss and degradation of these native habitats by increasing efforts to address coastal erosion, saltwater intrusion, and loss of freshwater and sediment inflows. Restoration of native prairie and prairie wetlands would occur on all suitable upland sites. A portion of the historic fresh and intermediate component of the Refuge Complex's coastal marshes would be restored and ongoing interior marsh loss addressed by working with agencies and other stakeholders on major hydrologic restoration projects that restore freshwater inflows and further restrict saltwater intrusion across watersheds, and through refuge-specific projects. Efforts to address coastal wetland loss resulting from shoreline erosion along the Gulf, Galveston Bay and the GIWW would be intensified by increasing coordination among agencies and other stakeholders to develop and implement major projects aimed at stabilizing shorelines, and by implementing smaller scale projects on the Refuge Complex. The Refuge Complex would continue to provide the current level of opportunities for all six of the National Wildlife Refuge System's priority wildlife-dependent recreational uses.

*Refuge Management Alternative D: **(Preferred Alternative)** Emphasis on an Integrated Management Approach Combining: 1) Expanded Habitat Management and Restoration Programs, 2) New Research and Wildlife Population Monitoring, and 3) Increased Efforts to Address Major Threats to the Ecosystem*

Under this Alternative, the Refuge Complex would continue and expand current habitat management and native habitat restoration programs, with increased monitoring and research to assess management actions and facilitate an adaptive management approach. Wetland habitat management activities for waterfowl, shorebirds and other wetland-dependent migratory birds including prescribed burning, controlled grazing, management of marsh semi-impoundments, and moist soil management would be refined and expanded through development of new infrastructure. Concurrently, additional restoration of native habitats including wetlands, prairie and woodlots would be undertaken to benefit a variety of native fauna, with a focus on priority species identified as in need of conservation actions through national and international conservation initiatives.

Additional shoreline protection and hydrologic restoration projects would be implemented on the Refuge Complex and coordination with other agencies would be expanded to address shoreline erosion and interior marsh loss on a landscape scale. Implementation of major projects that protect, restore and enhance coastal marshes by restoring freshwater inflows, providing sediments through the beneficial use of dredge materials, restricting saltwater intrusion, and protecting shorelines would be the goal of this interagency coordination and cooperation. Through new partnerships with universities and other agencies, additional research and monitoring would be conducted to assess the impacts of relative sea level rise and to gather baseline data on fish and wildlife populations and habitat use with an emphasis on documenting the status of several sensitive or declining species. The Refuge Complex would also continue to provide and promote opportunities for all six of the National Wildlife Refuge System's priority wildlife-dependent recreational uses: hunting, fishing, wildlife observation and photography, and environmental education and interpretation. The Refuge Complex would seek to improve the quality of visitor services and of the visitor experience.

Refuge Management Alternative E: Emphasis on a Passive Management Approach

Under this Alternative, the Refuge Complex would change its management focus from active habitat management and restoration to a more passive management approach, in which plant communities and wildlife populations are influenced primarily by natural events such as lightning-caused fires, herbivory by native wildlife, and tidal or stream flooding. Active habitat management and restoration activities including prescribed burning, controlled cattle grazing, rice farming and moist soil management would be discontinued. Management of water levels and salinities through active manipulation of water control structures would be discontinued. Efforts to address threats to ecosystem health would focus on monitoring rather than active restoration or protection. The Refuge Complex would continue to provide opportunities for all six of the National Wildlife Refuge System's priority wildlife-dependent recreational uses: hunting, fishing, wildlife observation and photography, and environmental education and interpretation, but administrative oversight and management would occur at reduced levels.

Elements Common to All Refuge Management Alternatives

Although the Refuge Management Alternatives all differ in their emphasis and focus, the management programs for each of the Alternatives have a number of elements or features common to all. Following is a description of those elements or features common to all of the Refuge Management Alternatives:

Complete Land Acquisition within Current Refuge Boundaries

The remaining lands within the current refuge boundaries will be acquired when, and if, the owners are willing to sell and funding is available. This is relevant only at McFaddin NWR because all the lands within the current refuge boundaries have already been acquired at the other refuges within the Refuge Complex. Acquisition of the remaining lands would not alter the emphasis or implementation within each of the different Refuge Management Alternatives.

Wilderness Review

The USFWS is required to conduct a wilderness review for each refuge as part of the CCP process. A wilderness review is the process used by the USFWS to determine whether or not to recommend lands or waters in the National Wildlife Refuge System to Congress for designation as a wilderness. A detailed Wilderness Review for each of the refuges within the Refuge Complex is contained in Appendix F in this document. The Wilderness Review and the recommendation to not include any of the Refuge Complex' lands or waters in the Wilderness System is valid for all of the Refuge Management Alternatives.

Protection of Cultural Resources

Cultural resources are those physical remains, objects, historic records, and traditional life ways that connect us to our nation's past. They include archaeological resources, historic properties, buildings/structures, Indian sacred sites, museum collections, objects of antiquity, and similar cultural properties. As a Federal agency, the USFWS is responsible for carrying out an array of laws and regulations concerning cultural resources. Some of the more important Federal cultural resources protection statutes are: the Antiquities Act, the Historic Sites Act, the National Historic Preservation Act, and the Archaeological Resources Protection Act. The purpose of the Federal historic preservation program is to ensure that cultural resources are duly considered as Federal agencies carry out their missions. The USFWS will ensure the same level of cultural resource protection required by law under each of the Refuge Management Alternatives.

Protection for Research Natural Areas (RNAs)

Research Natural Areas (RNAs) on national wildlife refuges are part of a national network of designated lands permanently reserved for research and educational purposes. They are intended to represent the full array of North American ecosystems, biological communities, habitats, and phenomena; and geological and hydrological formation and conditions, all intended for research purposes. RNAs are areas where natural processes are allowed to predominate without human intervention. Under certain circumstances, however, deliberate manipulation is used to maintain unique features that the RNA was established to protect (Refuge Manual, 8 RM 10). RNA's were originally intended to be treated as a kind of "wilderness" concept without the strict constraints placed on officially designated wilderness areas. They are intended to promote the naturalness of the area and encourage universities and other conservation groups to conduct research of these areas.

There is one RNA within the Texas Chenier Plain Refuge Complex. The Lone Tree Bayou Research Natural Area was designated on February 3, 1967 and is located within the Anahuac NWR. This RNA consists of approximately 200 acres of A7 Tidal Salt Marsh located along Lone Tree Bayou, a tributary of Oyster Bayou. It is managed for native plant associations and provides important habitat for a variety of native fauna including waterfowl, wading birds, alligators, and several marine fish and shellfish species. The Lone Tree Bayou Research Natural Area will be afforded the same level of protection under all of the Refuge Management Alternatives.

Detailed Description of Refuge Management Alternatives

The following sections contain a detailed narrative description of each Refuge Management Alternative along with the array of goals, objectives and strategies. While the goals do not vary between Alternatives, the objectives and strategies vary to differentiate the specific approaches to managing resources.

Each of the Refuge Management Alternatives contains a particular management emphasis or combination of emphases that distinguishes that alternative from the others. These emphases directly or indirectly influence the composition of the compendium of objectives and strategies derived from a particular alternative. Each alternative carries with it a particular philosophy or perspective that translates into a set of objectives and strategies that drive the achievement of the refuge goals and thus, become

the heart of the CCP. It is through this process that the USFWS eventually chooses its management direction leading to the fulfillment of the refuge purposes and the realization of its overall vision.

I. REFUGE MANAGEMENT ALTERNATIVE A (NEPA NO ACTION ALTERNATIVE) - CONTINUATION OF CURRENT MANAGEMENT

Alternative A Concept

Management Focus

Under this Alternative, current management programs on the Refuge Complex would continue unchanged. Management of wetland habitats including coastal marsh and freshwater wetlands to benefit waterfowl, shorebirds, wading birds, and other wetland-dependent migratory birds would continue at current levels and intensities using water level and salinity management, prescribed burning, grazing, cooperative rice farming, moist soil management, and mowing and haying. Restoration and protection of native habitats including wetlands, prairie and woodlands would proceed at current annual acreage rates and using existing techniques. Refuge staff would continue to provide technical assistance to private landowners wishing to enhance wetland and upland habitats for waterfowl and other wildlife on private lands.

The Refuge Complex biological program involving systematic field surveys to monitor population status and trends of migratory birds including waterfowl, shorebirds and neotropical and nearctic migratory songbirds, alligators, and habitats would continue. Periodic research would be conducted through partnerships with universities and the U.S. Geological Survey Biological Resources Division.

Ongoing efforts to address threats to ecosystem health posed by relative sea level rise and hydrological alterations, invasive/exotic species and contaminants would continue. These include coordination with other agencies and conservation organizations on ongoing planning processes and studies aimed at developing solutions to address coastal land loss, continuing to implement small-scale erosion abatement projects along the Gulf of Mexico, Galveston Bay and the Gulf Intracoastal Waterway through interagency partnerships, and maintaining existing shoreline restoration projects. Exotic plant and animal control programs would continue at current levels. Periodic monitoring of contaminant levels in air, soil and water and fish and wildlife resources would be conducted through the USFWS' Environmental Contaminants program.

The Refuge Complex would continue to provide opportunities for all six of the Refuge System's priority wildlife-dependent recreational uses, including hunting, fishing, wildlife observation and photography, and environmental education and interpretation through the use of existing programs and facilities.



Administration of refuge management programs would continue using existing staffing levels, facilities and equipment.

Rationale for this Management Focus

The coastal marshes, prairies and woodlots of the Chenier Plain region of southwestern Louisiana and southeast Texas comprise a hemispherically important biological area. The Texas Gulf Coast is the primary site for ducks wintering in the Central Flyway, with an average of 1.3-4.5 million birds, or 30-71% of the total Flyway population (Stutzenbaker and Weller 1989). This area also winters 90% of the snow, Canada, and greater white-fronted geese in the Central Flyway (Buller 1964). Additionally, the coastal marshes, prairies and prairie wetlands of the Chenier Plain region of the Texas Gulf Coast serve as a critical staging area for Central Flyway waterfowl migrating to and from Mexico and Central and South America. Hundreds of thousands shorebirds, wading birds, and other marsh and waterbirds also winter or migrate through the region, including several now identified by the USFWS as Avian Species of Conservation Concern. Coastal prairie and coastal woodlots support over 150 migratory and resident landbird species, including 9 species of grassland birds and 7 species utilizing woodland habitats listed as Rare and Declining within the Coastal Prairies Region of Texas (Texas Parks and Wildlife Department 2000). Overall, wetland, prairie and woodland habitats on the Refuge Complex provide habitat for 33 avian species designated by the USFWS as Avian Species of Conservation Concern in the Gulf Prairies Bird Conservation Region (USFWS 2005).

The high degree of alteration in this ecosystem has resulted in loss and degradation of native habitats, loss of biological diversity, and decreased habitat quality for migratory birds and other native wildlife. Alterations of historic hydrology including loss of freshwater inflows and increased saltwater intrusion in combination with sea level rise, land subsidence and interruption of mineral sediment supply are contributing to ongoing coastal land loss and marsh degradation. Almost all of the region's historic native tallgrass coastal prairie and its associated prairie wetlands have disappeared, and remaining coastal woodlots are imminently threatened by development and other land use changes. Several highly invasive exotic plant species are replacing native habitats and impacting natural biological diversity. Air and water quality issues in the region pose a potential contaminant threat to habitats and fish and wildlife, as do accidental spills and discharges from the major petrochemical shipping, storage, and processing facilities located in close proximity to sensitive habitats. Habitat losses to date and ongoing ecosystem threats are such that intensive management of remaining habitats, in combination with habitat restoration where feasible, are required to conserve fish and wildlife resources.

The Refuge Complex provides over 170,000 annual visitors opportunities to waterfowl hunt, fish for fresh and saltwater species, observe and photograph wildlife, and learn about this coastal ecosystem through interpretive and environmental education programs. Southeast Texas has a long and rich tradition of outdoor recreation. Demand for these recreational opportunities on public lands and waters is increasing. The human population in the 8-county area surrounding Houston now exceeds 6 million people, and the Texas Gulf Coast has become a popular nature tourism destination nationally and internationally.

A. USFWS Habitat Management and Restoration

The primary focus of USFWS land management activities on the Refuge Complex is to fulfill the establishment purpose(s) for the Refuges, i.e., for the conservation and management of migratory birds and their habitats. A complete description of USFWS management activities and programs on the Refuge Complex is found in Chapter 3, Affected Environment.

The major habitat management and restoration activities implemented on the Refuge Complex by the USFWS can be grouped into three major categories:

- Wetland Specific Management and Restoration
 - Water level and salinity management in coastal marshes
 - Wetland restoration

- Moist soil management
 - Cropland management – cooperative rice farming program
- Upland Specific Management and Restoration
 - Native prairie restoration and management
 - Woodlot restoration and protection
- General Habitat Management and Restoration Activities
 - Fire Management –Wildland Fire Suppression and Prescribed Burning
 - Controlled Livestock Grazing
 - Invasive Species Management
 - Shoreline Protection and Restoration
 - Mowing and Haying

These habitat management and restoration activities focus on achieving the following two Refuge goals:

- GOAL 1. Conserve, enhance and restore the Texas Chenier Plain region's coastal wetlands to provide wintering, migrational, and nesting/brood-rearing habitat for waterfowl, shorebirds, marsh and wading birds, other wetland-dependent birds, and habitat for other native fish and wildlife.
- GOAL 2. Conserve, enhance and restore the Texas Chenier Plain region's coastal prairies and coastal woodlands to provide wintering, migrational, and nesting habitat for resident and migratory landbirds, including neotropical/nearctic migratory birds, and habitat for other native wildlife species.

1. Wetland Specific Management and Restoration

Managed marsh units within the Refuge Complex are under varying degrees of structural control, and may best be described as marsh semi-impoundments. Some units are entirely or almost entirely behind man-made levees and water control structures and are intensively managed through manipulation of water control structures. Most are managed less intensively, relying to some degree on natural topography and drainage to control hydrologic regimes.

The typical water management regime for managed marshes on the Refuge Complex involves maintaining salinities within the range of the particular marsh type being targeted. Salinity inputs may be increased to higher than target levels if required to control aquatic invasive species. The general water level management regime across most of the Refuge Complex involves maintaining pre-determined water levels which provide favorable conditions for dabbling ducks and geese during fall and winter. Following the wintering migratory bird season, marsh units are allowed to draw down gradually to create soil conditions favorable for the germination of a variety of seed producing annual plants in emergent marshes and water levels conducive to the germination and establishment of submerged and floating aquatic plants in open water habitats. Summer water levels are maintained to promote the growth of these species.

a. Emergent Wetlands

The objective for Emergent Wetlands (Estuarine and Palustrine) is to maintain the historic continuum of fresh, intermediate, brackish and saline coastal marshes on the Refuge Complex, and to maintain a diversity of marsh plant communities both in species composition and vegetational structure (stem densities and height). Habitat values for waterfowl, shorebirds and many wading bird species are greatly enhanced in slightly brackish to fresh marshes containing several perennial and annual plant species (primarily grasses and sedges) which provide important food resources, and where disturbance reduces the height and/or density of vegetation. Perennial emergent plants important to wintering waterfowl include seashore paspalum (*Paspalum vaginatum*) and Olney bulrush (*Scirpus olneyi*). Early successional emergent plant species important as waterfowl food producers also include annual grasses such as millet (*Echinochloa* spp.) and sprangle-top (*Leptichloa fascicularis*) and forbs such as water hyssop (*Bacopa monnieri*) and purple ammania (*Ammannia coccinea*). Coastal marshes have evolved with a disturbance regime which includes fire, herbivory by native wildlife and more recently livestock, and infusion of saline waters during tidal surges associated with tropical storms and hurricanes. Water level and salinity management, prescribed burning, and controlled grazing are available tools for influencing plant communities (species composition and structure) in marsh habitats.

Current USFWS management activities in emergent wetlands:

- Actively manage water levels and salinities in managed marsh units (approximately 30,000 acres of semi-impoundments and impoundments on the Refuge Complex) utilizing water control structures, levees and water delivery and drainage infrastructure to maintain a continuum of brackish to fresh conditions and desirable marsh hydroperiods (wetting and drying cycles).
- On Texas Point NWR, utilize passive water management with rock weirs to reduce saltwater intrusion and restore hydrology.
- On Moody NWR, monitor non-development conservation easement.

- Conduct a rotational prescribed burning program in emergent marsh habitats on the Refuge Complex, with an annual burning objective of 12,000-15,000 acres. Prescribed burns are conducted primarily in fall and early winter (late September to early December). Conduct wildland fire suppression activities with full consideration of natural resource objectives.
- Conduct a rotational grazing program on approximately 41,000 acres of marsh and upland habitats on the Refuge Complex.
- Manage muskrat and nutria populations on the Refuge Complex utilizing trapping under Special Use Permit for nuisance animal control when necessary to prevent damage to emergent marsh habitats.

b. Open Water Wetlands (Estuarine and Palustrine)

The objective for Open Water Wetlands (Estuarine and Palustrine) is to produce a diverse and healthy annual crop of submerged and floating aquatic vegetation in ponds and other open water habitats, and to maintain a desirable interspersed of open water and emergent marsh habitats on the Refuge Complex. The diversity and productivity of aquatic plant communities are also dependent upon maintenance of the historic continuum of fresh to saline marsh types. The submerged aquatic plant community serves as a direct source of important waterfowl foods (e.g., seeds and tubers), and indirectly, as a rich environment for aquatic macroinvertebrates, which are heavily utilized by waterfowl and many other wetland birds (Baldassarre and Bolen 1994). These habitats are extremely important for brood-rearing and molting Mottled Ducks (Stutzenbaker 1988), and these habitats are important to fishery resources providing vital nursery habitat for many species of marine fish and shellfish (Stutzenbaker and Weller 1989). Water level and salinity management within marsh semi-impoundments are important tools for restoring and maintaining submerged aquatic vegetation production and species diversity. Common reed (*Phragmites communis*), cattail (*Typha* spp.) and California bulrush (*Scirpus californicus*) are aggressive plant invaders which can form dense homogeneous stands in open water habitats in brackish to fresh marshes. In fresh marsh environments, establishment and expansion of maiden cane (*Panicum hemitomen*) and giant cutgrass (*Zizaniopsis miliacea*) can also result in loss of open water habitats. Submerged aquatic vegetation production is substantially reduced due to shading and loss of substrate when extensive encroachment by these species occurs.

Current USFWS management activities in open water wetland habitats:

- Manage water levels and salinities in managed marsh units (semi-impoundments and impoundments) to maximize the annual production of desirable submerged and floating aquatic plants.
- Utilize an integrated management approach involving salinity and water level management, prescribed burning, controlled grazing, herbicide application and mechanical manipulation to control invasive emergent plant encroachment into open water habitats.

c. Freshwater Prairie Wetlands (Palustrine)

The objective in Freshwater Prairie Wetlands (Palustrine) is to maintain approximately 1,000 -1,200 acres of managed and natural shallow freshwater wetlands on the Refuge Complex. The loss of native prairie habitats and their associated shallow prairie wetlands have been substantial along the Texas Coast (Moulton *et al.* 1997). A large portion of the upper Texas Coast prairie habitats have been cultivated for rice production, which provides valuable habitat for waterfowl, shorebirds, and many other migratory birds (Hobaugh *et al.* 1989, Wilson 2001). However, rice production has declined significantly during the last decade in counties surrounding the Refuge Complex, reducing available prairie wetland habitat for waterfowl, shorebirds and other wetland-dependent species. Mottled Ducks heavily utilize prairie habitats adjacent to freshwater wetlands for nesting (Stutzenbaker 1988).

Current USFWS management activities in freshwater “prairie” wetlands:

- Farm 500-700 acres of rice annually through a cooperative farming program on Anahuac NWR.
- Manage approximately 500 acres of moist soil units annually on Anahuac NWR. Of these, 150 acres are managed to provide freshwater habitat during spring and summer for brood-rearing

Mottled Ducks, and 100 acres are managed to provide migrational habitat for shorebirds during spring and fall.

- Mow (and/or hay) 100 acres of transitional wet prairie annually on Anahuac NWR to enhance migrational and wintering habitat for waterfowl and shorebirds.

2. Upland Specific Management and Restoration

a. Native Prairie and other Grasslands

The objective for native prairie and other grasslands is to protect and manage 5,744 acres on non-saline grasslands on the Refuge Complex, including “prairie remnants”, permanently fallowed former croplands which are naturally revegetating, and sites previously restored using intensive restoration techniques. An additional 245 acres of fallowed croplands would be restored on Anahuac NWR under this Alternative. It is now estimated that 99.8% and 99.6 % of little bluestem and eastern gamma grass/switch grass prairies, respectfully, have been lost in Texas (McFarland 1995). Nine of the 13 avian species listed as Rare and Declining within the Coastal Prairies Region in Texas (Texas Parks and Wildlife Department 2000) are present in grasslands on the Refuge Complex. In 2005, the USFWS listed 7 avian species occurring in prairie habitats on the Refuge Complex as Avian Species of Conservation Concern in the Gulf Prairies Bird Conservation Region. Intensive restoration of native prairie and enhancement of existing grassland habitats through an integrated management approach utilizing prescribed fire, exotic plant control, controlled grazing and mowing (and/or haying) is needed on the Refuge Complex to provide high quality nesting and wintering habitat for prairie-dependent avian species and other wildlife.

Current USFWS management activities in native prairie and other grassland habitats:

- Conduct spring prescribed burning, rotational controlled grazing, mowing (and haying) and invasive plant control to maintain and enhance existing 5,744 acres of grassland habitats on the Refuge Complex. Conduct wildland fire suppression activities with full consideration of natural resource objectives.
- Increase native prairie plant diversity by planting and sprigging native grasses and forbs within existing grassland habitats on Anahuac NWR.
- Through partnerships with conservation organizations and volunteers, conduct native prairie restoration using intensive restoration techniques on an additional 245 acres on Anahuac NWR in the following management units: Curlew Prairie, Field 51, VIS Prairie Demonstration, Onion Bayou Prairie and Saltcedars. Intensive restoration techniques include exotic plant control/removal, restoring natural contours and hydrology by removing cropland levees and other infrastructure, and seeding with native prairie seed mixtures.

b. Coastal Woodlands

The objective for Coastal Woodlands is to protect and enhance the existing 127 acres of woodland habitats on the Refuge Complex. Coastal woodlots in the Chenier Plain region are extremely important to migrating songbirds, providing essential feeding and resting areas for numerous neotropical migratory birds crossing the Gulf of Mexico (Rappole 1974, Sprunt 1975, Mueller 1981). Although comprising less than 1% of Refuge Complex acreage, woodland habitats are extremely important to overall avian diversity, including several sensitive species. Six of the 7 avian species listed as Rare and Declining within the Coastal Prairies Region in Texas (Texas Parks and Wildlife Department 2000) are present in Refuge Complex woodlands. In 2005, the USFWS listed 4 species that occur in Refuge Complex woodlands as Avian Species of Conservation Concern in the Gulf Prairies Bird Conservation Region.

The amount of native coastal woodlot habitat in the Chenier Plain region has been reduced mainly through development, conversion to pasture and logging of bottomland hardwoods (Mueller 1981). Although woody habitat has significantly increased in the region with the rapid expansion of exotic Chinese tallow trees, these new tallow woodlands provide poor habitat for migrant songbirds (Barrow and Renne 2001).

Current USFWS management activities in coastal woodlands:

- Protect and enhance existing 127 acres of woodlands on the Refuge Complex using fencing, invasive plant control, and native tree and shrub plantings to diversify woodlots and create additional understory.

B. USFWS Biological Program – Surveys, Monitoring, and Research

USFWS habitat management and restoration activities benefit many species of native fish, wildlife and plants on the Refuge Complex. The USFWS biological program on the Refuge Complex includes monitoring, field surveys and research studies of fish and wildlife population status, population trends and habitat utilization. The information obtained allows the USFWS to adapt management efforts on the Refuge Complex as needed to achieve Refuge purposes and to maintain and restore natural biological diversity and biological integrity.

These fish and wildlife conservation efforts focus on achieving the following Refuge goal:

- GOAL 3. A comprehensive biological program will guide and support conservation efforts for all species of native fish, wildlife and plants on the Texas Chenier Plain Refuge Complex.

1. Waterfowl, Shorebirds, and other Wetland-Dependent Migratory Birds

The biological program's objective for waterfowl, shorebirds and other wetland-dependent migratory birds is to help maintain healthy populations of species utilizing the Refuge Complex, and to document population status and trends and habitat utilization of priority species. Coastal habitats of the Texas Chenier Plain region provide important wintering and migration habitat for waterfowl of the Central Flyway, and for millions of shorebirds, wading birds, colonial nesting waterbirds, and other wetland-dependent migratory birds. Monitoring and studies of population trends and habitat utilization provide information to assess management activities on the Refuge Complex. Data are also used in support of international, national and regional migratory bird conservation initiatives.

Current USFWS biological program and management activities supporting conservation of waterfowl, shorebirds and other wetland-dependent migratory birds:

- Conduct monthly aerial surveys of wintering and migrating waterfowl (September through March) of the four refuges on the Refuge Complex.
- Conduct periodic spring and fall shorebird surveys in various representative wetland habitats on Anahuac NWR.
- On Anahuac NWR, manage 100 acres of moist soil units annually to provide freshwater wetland and mudflat habitat for shorebirds during spring and fall migrations.
- Conduct annual nesting survey for colonial nesting waterbirds on Gulf shoreline of Texas Point NWR.
- Participate in national, regional and local banding studies of migratory waterfowl and other migratory birds, including ongoing banding studies of Mottled Ducks and Snow Geese.
- Facilitate and support occasional research studies on priority species through partnerships with universities and the U.S. Geological Survey Biological Resources Division.
- Collect data from harvested waterfowl at check stations on Anahuac and McFaddin NWR including body condition indices and lead shot ingestion rates.
- Participate in the annual Audubon Society Christmas Bird Count.
- Maintain existing nesting habitat site for Least Terns on McFaddin NWR.
- Coordinate with the U.S. Army Corps of Engineers to evaluate and develop opportunities for creating colonial water bird habitat through the beneficial use of dredge material.

The objective for Mottled Ducks, an important resident waterfowl species, is to increase breeding populations to long-term average levels by maintaining favorable habitat conditions including nesting, brood-rearing, molting and wintering habitats. Both spring breeding pair and September aerial surveys conducted by the USFWS indicate a steady decline in Mottled Duck populations on coastal national wildlife refuges in Texas over the last 16 years. While drought conditions along much of the Texas Coast

during late 1990's undoubtedly contributed to this decline, other potential causative factors include loss of freshwater wetlands and upland nesting habitat due to land use changes, loss of pair bond, brood rearing and molting habitats due to invasive plant encroachment in open water habitats, brush encroachment in nesting habitats, increased predation by alligators, mammalian predators and fire ants, and lead shot ingestion rates that have remained high in some areas.

Current USFWS biological program and management activities supporting conservation of Mottled Ducks include:

- Conduct annual Mottled Duck breeding pair survey on Texas coastal refuges (including Anahuac NWR) in March.
- Conduct banding program on the Refuge Complex and adjacent private lands in cooperation with Texas and Louisiana state wildlife agencies.
- Coordinate with USFWS Division of Migratory Birds on specific research needs and support research activities.
- On Anahuac NWR, manage 150 acres of moist soil units annually specifically to provide brood rearing habitat for Mottled Ducks during summer.
- Utilize water level and salinity management, prescribed burning, and rotational grazing in managed marsh units (semi-impoundments and impoundments) to provide quality Mottled Duck brood-rearing, molting, and wintering habitat.
- Maintain quality nesting habitat utilizing an integrated brush control program which include, prescribed burning, controlled grazing, herbicide application, and mowing to reduce brush encroachment in salty prairie habitats, on levees and along fence lines.

2. Migratory and Resident Landbirds

The biological program's objective for migratory and resident landbirds is to help maintain healthy populations of species utilizing the Refuge Complex, and to document population status and trends and habitat utilization of priority species. Coastal habitats of the Texas Chenier Plain region provide important wintering, migrating and nesting habitat for migratory and resident landbirds. Monitoring and study of population trends and habitat utilization provides information to assess management activities on the Refuge Complex. Data are also used in support of international, national and regional migratory bird conservation initiatives.

Current USFWS biological program activities supporting conservation of migratory and resident landbirds:

- Conduct periodic surveys of migratory and resident landbirds on the Refuge Complex, including neotropical and nearctic migrants, in marsh, prairie and woodland habitats.
- Facilitate and support occasional research studies on priority species on the Refuge Complex through partnerships with universities and the U.S. Geological Survey Biological Resources Division.
- Participate in the annual Audubon Society Christmas Bird Count. Two area counts include the Anahuac and McFaddin/Texas Point NWRs.

3. Fish and other Aquatic Species

The biological program's objective for fish and other aquatic species is to ensure healthy populations and document population trends, status and habitat utilization of priority species on the Refuge Complex. Estuarine marsh habitats support over 95% of the Gulf of Mexico's commercial and recreational fisheries species during some portion of their life cycles. The continuum of fresh to saline aquatic environments on the Refuge Complex support highly diverse aquatic vertebrate and invertebrate communities.

A second objective for fish and other aquatic species is to incorporate fisheries and aquatic resource management into the management of all estuarine marshes on the Refuge Complex.

Current USFWS biological program and management activities supporting conservation of fish and other aquatic species:

- Working with the USFWS' Division of Fisheries, continue to support and facilitate periodic monitoring of fishery resources.
- Retrofit existing water control structures and incorporate design features in any new structures to facilitate ingress and egress of living marine organisms in estuarine marshes.
- Enhance marine organism access to and from managed marshes by managing water control structures to facilitate passage during key movement periods.

4. Threatened and Endangered Species, Species of Conservation Concern

The biological program's objective for Threatened and Endangered species, Species of Conservation Concern, and other "watch species" is to support recovery efforts and to obtain information on population trends, status and habitat utilization of sensitive and/or declining species utilizing the Refuge Complex. Eight federally-listed Threatened and Endangered species occur on or adjacent to the Refuge Complex: Bald Eagle, Piping Plover, Brown Pelican, Loggerhead sea turtle, Kemp's Ridley sea turtle, Green sea turtle, Hawksbill sea turtle, and Leatherback sea turtle. The sea turtles are found offshore in the Gulf and in Galveston Bay, but no nesting on beaches has been documented on the Refuge Complex. The Refuge Complex also provides important habitat for 33 avian species identified by the USFWS as Avian Species of Conservation Concern within the Gulf Prairies Bird Conservation Region. Nine out of the 13 avian species listed by the Texas Parks and Wildlife Department as rare and declining species in coastal prairies and marshes in Texas are found on the Refuge Complex. The Texas Parks and Wildlife Department lists three species of reptiles which occur or potentially occur on the Refuge Complex as threatened: the smooth green snake, alligator snapping turtle and the Texas horned lizard. Several additional species of reptiles and amphibians are listed in the Texas Natural Heritage Database, now maintained by The Nature Conservancy's Texas Conservation Data Center.

Current USFWS biological program activities supporting conservation of Threatened and Endangered species and other species of conservation concern:

- Participate in the annual coast-wide wintering Piping Plover survey.
- Report all incidences of stranded sea turtles to National Marine Fisheries Service.
- Document the occurrence of Threatened and Endangered species and species of conservation concern on the Refuge Complex during field surveys.
- Facilitate and support occasional research studies on priority species through partnerships with universities and the U.S. Geological Survey Biological Resources Division.

5. Mammals

The biological program objective for mammals on the Refuge Complex is to help maintain healthy populations and natural diversity and to document population status and trends and habitat utilization of priority species. Coastal habitats of the Texas Chenier Plain region support a diverse mammalian community.

Current USFWS biological program activities supporting conservation of mammals:

- Document the occurrence of mammals on the Refuge Complex during field surveys for other species.
- Facilitate and support occasional research studies on mammals through partnerships with universities and the U.S. Geological Survey Biological Resources Division.
- Control muskrat populations as needed to prevent damage to emergent marsh habitats through issuance of Special Use Permit for trapping and removal.

6. Reptiles and Amphibians

The biological program objective for reptiles and amphibians is to maintain healthy populations and natural diversity, and to document population status and trends. The objective for alligators is to maintain

alligator populations at self-sustaining levels, but at densities consistent with migratory bird management objectives. The American alligator was first afforded protection under the Endangered Species Act in the late 1960's. Since then, populations have increased dramatically throughout its range. Nest counts conducted by the Texas Parks and Wildlife Department indicate a substantial increase in alligator numbers throughout its range in Texas (TPWD, Annual Alligator Reports). Survey information on McFaddin NWR indicates a greater than 200% increase in the refuge alligator population during the past decade; a similar increase has been noted on Anahuac NWR.

Current USFWS biological program activities supporting conservation of reptiles and amphibians:

- Administer an adult alligator harvest program as a compatible refuge economic use on the Anahuac and McFaddin NWRs under the Texas Parks and Wildlife Department's alligator management program.
- Conduct annual basking and nighttime spotlight surveys on Anahuac and McFaddin NWRs to monitor alligator population trends.
- Monitor recoveries of marked alligators on McFaddin NWR to enhance population trend monitoring.
- Continue coordination and information sharing with the Texas Parks and Wildlife Department on alligator harvest management, population monitoring, and research.
- Facilitate and support occasional research studies on sensitive and/or declining species through partnerships with universities and the U.S. Geological Survey Biological Resources Division.

7. Invertebrates

The biological program objective for invertebrates is to maintain healthy populations and natural diversity, and to document species occurrence on the Refuge Complex.

Current USFWS biological program activities supporting conservation of invertebrates include:

- Work with partners to conduct baseline inventories of species occurrence and relative abundance. Cooperate with established inventory programs such as "Bio-Blitz" and annual North American Butterfly Association count.

8. Plant Resources

The biological program objective for plant resources is to maintain native plant species diversity and to document native species composition and plant community changes over time on the Refuge Complex. Natural disturbances such as drought and floods, fire and herbivory by wildlife, and management activities such as grazing, prescribed burning, water level and salinity management all impact plant communities on the Refuge Complex. Sea level rise, subsidence and invasive plant and animal species are now also impacting native plant communities. Understanding how these events, processes and management activities affect plant community dynamics is essential to ensure long-term conservation of plant resources.

Current USFWS biological program activities supporting conservation of plant resources:

- Assess habitat response to management activities including prescribed burning and grazing and natural perturbations such as fire and hurricanes through systematic field vegetation surveys and monitoring.
- Facilitate and support periodic research and monitoring of plant resources and factors such as sea level rise, subsidence and exotic species which are impacting plant resources through partnerships with universities and the U.S. Geological Survey Biological Resources Division.

C. Addressing Threats to the Ecosystem

The USFWS has ongoing efforts on the Refuge Complex to address threats to ecosystem health posed by relative sea level rise, hydrological alterations, exotic species, and contaminants. These include coordination with other agencies and conservation organizations on ongoing planning processes and

studies aimed at developing solutions to address coastal land loss due to erosion along the Gulf of Mexico, and to implement erosion abatement projects along the Gulf of Mexico, Galveston Bay and the Gulf Intra-coastal Waterway.

These efforts addressing threats to ecosystem health focus on achieving the following Refuge goal: GOAL 4. By working with others locally and on a landscape level, threats to biological integrity, biological diversity, and environmental health on the Texas Chenier Plain Refuge Complex will be addressed.

1. Coastal Land Loss

The objective for the threat from relative sea level rise and reduced sediment supply is to decrease rates of coastal land loss due to shoreline erosion along the Gulf of Mexico, East Galveston Bay, and the GIWW. Along the Texas Coast, wetland losses between the mid-1950's and mid-1990's were most substantial for estuarine emergent marshes (Moulton *et al.* 1997). Relative sea level rise and reduced coarse sediment supply to Gulf and bay nearshore littoral systems are resulting in significant loss of coastal habitats. Average rates of shoreline retreat along the Gulf adjacent to the refuges are as high as 50 feet per year on Texas Point NWR, and 10-15 feet per year along most of McFaddin NWR (Bureau of Economic Geology unpublished data, Morton 1998). Over 800 acres of dunes and emergent marsh has been lost due to Gulf shoreline erosion on these refuges during the last 25 years, and remaining inland marshes are increasingly threatened by more frequent inundation during high tidal events. Although less severe, erosion along the East Galveston Bay shoreline is also causing wetland loss on Anahuac NWR, and also threatens remaining marshes with saltwater intrusion. Erosion along the GIWW is causing direct loss of wetlands and poses a significant threat to marshes from saltwater intrusion on both McFaddin and Anahuac NWRs. Levees created when the GIWW was constructed have almost entirely eroded away along significant portions of its length within these refuges.

Current USFWS efforts addressing shoreline erosion and resulting land loss:

- Working with the Texas General Land Office and other partners, maintain existing dune restoration project and explore opportunities for additional dune restoration along the Gulf of Mexico on McFaddin NWR.
- Working with the Texas General Land Office and other partners, maintain existing shoreline protection and seek opportunities for additional protection along the GIWW shoreline on McFaddin NWR. Rock breakwaters, shoreline armoring, and emergent marsh plantings are methodologies currently in use.
- Coordinate with the U.S. Army Corps of Engineers and other partners to implement additional projects to beneficially use dredge materials from the Sabine-Neches Ship Channel to reduce land loss by restoring sediment supply to the Gulf shoreline and marshes on and adjacent to Texas Point NWR, and from the GIWW to restore sediment supply to marshes on McFaddin and Anahuac NWRs.
- Coordinate with the U.S. Army Corps of Engineers on their ongoing Section 227 National Shoreline Erosion Demonstration Project in Jefferson County, Sabine Pass to San Luis Pass Shoreline Erosion Feasibility Study for Galveston and Jefferson counties.
- Working with the Galveston Bay Foundation, Galveston Bay Estuary Program, and other conservation partners, maintain existing offshore rock wave breaks and restore emergent marsh by planting smooth cordgrass along the East Galveston Bay shoreline on Anahuac NWR.
- Coordinate with USFWS Partners for Fish and Wildlife and Coastal programs to implement shoreline protection projects on Moody NWR.

2. Altered Hydrologic Processes

The objective for the threat from altered hydrologic processes and resulting interior marsh loss is to protect existing and restore emergent coastal marsh habitat on the Refuge Complex by reducing saltwater intrusion, increasing freshwater and inflows and mineral sediment supply to marshes, and maintaining natural marsh hydroperiods. Land subsidence and sea level rise, channel construction, and channelization of natural waterways has had significant hydrologic impacts including saltwater intrusion, increased tidal energies causing erosion of organic marsh substrates, loss of freshwater inflows and

reduced mineral sediment supply to marshes, and excessive flooding or drainage/drying of marshes. Over the last century, these factors have gradually converted extensive areas of fresh and intermediate marshes to a more brackish regime thereby decreasing natural biological diversity, and in some areas have resulted in conversion of vegetated emergent marshes to open water (marsh loss). Relative sea level rise threatens further loss of vegetated marsh due to submergence and increased saltwater intrusion. To survive, remaining marshes must accrete or gain elevation at a rate that keeps up with relative sea level rise. Maintaining plant productivity and preventing loss of organic marsh soils by restricting saltwater intrusion and tidal energies, increasing freshwater inflows, and beneficially using dredge materials to increase mineral sediment supply appear to offer the most realistic options for reversing current trends of interior marsh loss in the Chenier Plain region.

Current USFWS efforts addressing altered hydrologic processes and marsh loss:

- Actively manage water levels and salinities in managed marsh units on Anahuac and McFaddin NWRs (semi-impoundments and impoundments) utilizing water control structures, levees and water delivery and drainage infrastructure to maintain a continuum of brackish to fresh conditions and desirable marsh hydroperiods (wetting and drying cycles). Utilize passive rock weirs to restore hydrology and decrease saltwater intrusion on Texas Point NWR.
- Coordinate with state and federal agencies and others to implement a hydrological restoration project aimed at stopping emergent marsh loss (conversion of emergent marsh to open water) on J.D. Murphree WMA, Sea Rim State Park and private lands in the eastern portion of the Salt Bayou watershed affected by the Keith Lake Fish Pass in Jefferson County.
- Coordinate with the U.S. Army Corps of Engineers, Texas General Land Office, Texas Parks and Wildlife Department, Texas Department of Transportation and others to develop strategies to restore and enhance wetlands throughout the Refuge Complex through the beneficial use of dredged material.

3. Invasive Species

The objective for the threat from invasive species is to utilize an integrated pest management (IPM) program to control invasive species (exotic and native species) on the Refuge Complex, emphasizing reduction and control of Chinese tallow. Monocultures of invasive plants reduce natural biological diversity, increase erosion, alter nutrient cycling and displace macro- and micro-fauna that depend on native plants for habitat and food (Sheley and Petroff 1999). Refuge habitats are currently significantly impacted by exotic plants and animals including: Chinese tallow (*Sapium sebiferum*), deep-rooted sedge (*Cyperus entrerianus*), water hyacinth (*Eichhornia crassipes*), alligator weed (*Alternanthera ohilcoeroides*), water lettuce (*Pistia stratiotes*), McCartney rose (*Rosa bracteata*), vasey grass (*Paspalum urvillei*), Johnson grass (*Sorghum halepense*), deep-rooted sedge (*Cyperus entrerianus*), Eurasian water milfoil (*Myriophyllum spicatum*), hydrilla (*Hydrilla verticillata*), common Salvinia (*Salvinia minima*) Japanese honeysuckle (*Lonicera japonica*) red imported fire ants, nutria, and feral hogs. Giant salvinia (*S. molesta*), to date documented on the Refuge Complex only once and in small amounts near a refuge boat ramp, has been found nearby and poses a significant threat to freshwater wetlands. Invasive native plant species include eastern baccharis (*Baccharis halimifolia*), big-leaf sumpweed (*Iva frutescens*), rattlebox (*Sesbania drummondii*), common reed (*Phragmites communis*) and cattail (*Typha* spp.).

Current USFWS efforts addressing invasive species:

- On the Refuge Complex, annually treat 25% of all Chinese tallow trees seven feet tall or 4" in diameter using basal bark herbicide applications, and utilize mowing, fire and spot herbicide applications on smaller plants.
- Utilize salinity management, mechanical removal and spot herbicide treatments to control water hyacinth near water control structures and in water delivery systems on the Refuge Complex.
- Utilize salinity management, fire, mowing and spot herbicide treatment to control invasive aquatic plants such as cattail and common rush on the Refuge Complex.
- Utilize fire and mowing to control brush encroachment by Eastern baccharis in Refuge Complex grassland habitats.
- Continue feral hog population control efforts on McFaddin and Anahuac NWRs.

- Coordinate with the Trinity Bay Conservation District and the Chambers-Liberty Counties Navigation District on control of aquatic and terrestrial invasive plants on waterways, canals and ditches and on banks and levees within drainage and irrigation easements through the Anahuac NWR.

4. Contaminants

The objective for addressing the threat from contaminants is to identify and assess contaminant threats to fish and wildlife resources on the Refuge Complex. Contaminant issues affecting the Refuge Complex include potential petroleum and petrochemical spills from: 1) on-Refuge oilfield operations; 2) shipping on the GIWW; and 3) offshore production in the Gulf and Galveston Bay. The potential for petrochemical and petroleum spills affecting the Refuge Complex is high. Several active oil and gas wells are currently producing on the Refuge Complex. Significant drilling and production activity occurs in Gulf waters offshore of McFaddin and Texas Point NWRs. The GIWW between Houston and Lake Charles, Louisiana is one of the busiest reaches of this waterway for shipping petrochemical and petroleum products. The GIWW parallels much of McFaddin and Anahuac NWRs, and the Sabine-Neches Ship Channel parallels Texas Point NWR. Former and current oil and gas production areas on the Refuge Complex contain extensive infrastructure which is no longer in use, including flow lines, pipelines, oil pits, well pads, and brine disposal areas. Many of these lines, pits and pads may contain contaminants including heavy metals, normal occurring radio-active material, brine, and petroleum products. In addition, Refuge Complex marshes comprise the downstream end of at least 10 waterways. Factories, refineries, solid waste disposal sites, oil field sludge disposal areas, feedlot operations, agricultural operations and housing developments are potential pollution sources in upstream reaches of these watersheds. Finally, high levels of lead shotgun pellets likely occur over much of the Refuge Complex. Incidence of lead shot in Mottled Duck gizzards remains relatively high to the present in birds harvested on the Anahuac and McFaddin NWRs, even after over 15 years of implementation of non-toxic ammunition regulations.

Current USFWS efforts addressing contaminants:

- Working with the USFWS Division of Ecological Services, conduct periodic monitoring and studies of contaminant levels and impacts to fish and wildlife resources on the Refuge Complex.
- Facilitate and support research and monitoring on contaminants and contaminant impacts to fish and wildlife resources on the Refuge Complex through partnerships with universities and the U.S. Geological Service Biological Resources Division.
- Coordinate with federal, state and local agencies on oil spill response planning, preparedness and implementation.
- Continue monitoring of lead shot ingestion rates in Mottled Ducks harvested on Anahuac and McFaddin NWRs.

5. New Oil and Gas Exploration and Development

Minerals underlying the refuges are privately held and the USFWS must allow reasonable use of the surface of refuges to explore for and develop oil and gas reserves. The objective for management of New Oil and Gas Exploration and Development is to ensure that new oil and gas exploration and development on the Refuge Complex is conducted in the most environmentally-sensitive manner possible by defining a process which facilitates close coordination with industry and timely processing of requests to conduct activities, and which mandates the use of scientifically-accepted "best management practices" for these activities in sensitive coastal environments.

Current USFWS efforts addressing new oil and gas development:

- Coordinate with oil and gas interests on all exploration and development activities on the Refuge Complex, and administer these activities under existing USFWS policy and regulations through issuance of Special Use Permits.

D. USFWS Public Use Program

The Texas Chenier Plain Refuge Complex offers a wide variety of recreational and environmental educational opportunities and received over 172,000 visitors during fiscal year 2002. Guidance for authorizing public uses on National Wildlife Refuges is provided in the National Wildlife Refuge System Improvement Act (the Act) of 1997 (P.L. 105-57). The Act states, "Compatible wildlife-dependent recreation is a legitimate and appropriate general public use of the System . . . through which the American public can develop an appreciation for fish and wildlife." Through the use of existing programs and facilities, the Refuge Complex provides opportunities for all six of the Refuge System's priority wildlife-dependent recreational uses, which are:

- Hunting
- Fishing
- Wildlife observation and photography
- Environmental education and interpretation

These visitor and recreational opportunities focus on achieving the following refuge goal:

- GOAL 5. All local, national and international visitors will enjoy safe and high quality outdoor experiences on the Refuge Complex, and learn of the Refuge Complex' role in conserving the region's coastal natural resources. New partnerships with our local communities will be forged to highlight, promote and conserve the unique natural assets of the upper Texas Gulf Coast.

1. Hunting

The objective for hunting is to provide safe and high quality waterfowl hunting opportunities on the Refuge Complex. Waterfowl hunting is a traditional and still very popular outdoor recreational pursuit in the region. Refuges and other public lands along the Gulf Coast play a key role in providing hunting opportunity to the public.

Current USFWS public use program activities supporting hunting:

- Provide waterfowl hunting opportunities on approximately 37,300 acres of the Refuge Complex. Opportunities include assigned area by reservation or drawing hunts, controlled entry hunts which limit overall numbers of hunters in a particular hunt unit, and unrestricted entry hunts. Reservation, drawing, and controlled entry hunts require a fee permit, while unrestricted hunts do not. All refuge hunters must possess a general refuge hunting permit.
- Administer the waterfowl hunt program under current regulations. Hunting on all hunt units is allowed 3 days per week until noon (except the Pace Tract on Anahuac NWR which is open seven days per week until noon).
- Maintain existing access facilities which support the hunting program including hunter check stations, roads, boat ramps, boat rollers, parking areas, foot bridges and waterways.
- Conduct routine law enforcement activities to protect public safety and natural resources.

2. Fishing

The objective for fishing is to provide safe and high quality fishing opportunities on the Refuge Complex. The Refuge Complex offers exceptional recreational fishing and crabbing opportunities in both saltwater and freshwater environments. Catfish, bass and brim in freshwater environments and speckled trout, flounder and red drum in saltwater environments are among the popular game fish species on the refuges. Crabbing for blue crabs is also a popular recreational pursuit along refuge waterway and lake shorelines.

Current USFWS public use program activities supporting fishing:

- Maintain existing access facilities which support the fishing program including roads, boat ramps, parking areas, fishing piers and trails.
- Host annual National Fishing and Boating Week event on Anahuac NWR.
- Conduct routine law enforcement activities to protect public safety and natural resources.

3. Wildlife Observation and Photography

The objective for wildlife observation and photography is to provide safe and high quality opportunities for wildlife observation and photography on the Refuge Complex. The Refuge Complex provides local, regional, national and international visitors with a wide range of wildlife observation and photography opportunities, supporting a rapidly growing nature tourism industry in Texas. Migratory bird and alligator viewing are the main attractions. The refuges are highlighted Upper Texas Gulf Coast sites on the Great Texas Birding Trail. Anahuac NWR is an internationally known birding destination, receiving visitors each year from all 50 states and over 20 countries.

Current USFWS public use program activities supporting wildlife observation and photography:

- Maintain existing facilities which support wildlife observation and photography including the Anahuac NWR Visitor Information Station, and roads, parking areas, trails, observation platforms, boardwalks, and photography blinds.
- Conduct routine law enforcement activities to protect public safety and natural resources.

4. Environmental Education and Interpretation

The objective for environmental education and interpretation is to provide safe and high quality opportunities for environmental education and interpretation on the Refuge Complex. The implementation of environmental education and interpretive programs for students and visitors on the Refuge Complex is important to increase the quality of the visitor experience and to further public awareness of the benefits, issues and challenges associated with natural resource conservation in this productive and diverse coastal ecosystem.

Current USFWS public use program activities supporting environmental education and interpretation include:

- Through a partnership with the Friends of Anahuac Refuge, refuge volunteers and local school districts, provide an environmental education program on Anahuac NWR for kindergarten through fifth grade students. Specific curricula have been developed for each grade. Over 1,000 students annually are taught during field trips to the refuge, and through an in-school reading program.
- Provide guided tours and interpreted nature walks for visitors on Anahuac NWR in partnership with the Friends of Anahuac Refuge and volunteers.
- Maintain existing facilities which support environmental education and interpretation including the Anahuac NWR Visitor Information Station, roads, parking areas, trails, interpretive signs, observation platforms, and boardwalks.
- Host annual educational special events including the Youth Waterfowl Expo and National Fishing Week celebration on Anahuac NWR and Marsh Madness on McFaddin NWR and participate in educational activities at local and regional festivals including the Texas GatorFest and the Texas Rice Festival.
- Conduct routine law enforcement activities to protect public safety and natural resources.

5. Beach Uses on McFaddin NWR

The objective for beach uses on McFaddin NWR is to protect public safety and natural resources along the Gulf of Mexico shoreline within the refuge. The beaches along the Gulf of Mexico on and adjacent to the McFaddin NWR support recreational uses including surf fishing, swimming, sunbathing, wildlife observation, and camping. The beaches on McFaddin NWR are considered an area of joint Federal and State of Texas jurisdiction. The beach inland of the Mean High water line lies within the Refuge. Motorized vehicular traffic occurs on the beach from the vegetation line seaward to mean low tide line, on the public beach easement established under the State of Texas "Open Beaches Act" (*Texas Natural Resources Code, Chapter 61: Use and Maintenance of Public Beaches*).

Current USFWS public use program activities related to beach use on McFaddin NWR include:

- Conduct routine law enforcement activities to protect public safety and natural resources.

E. Community Outreach and Partnerships

The objective for community outreach and partnerships is to promote conservation of natural resources by working effectively with partners in support of USFWS management programs on the Refuge Complex including habitat management and restoration, fish and wildlife population management, and providing public recreational and educational opportunities. Partnerships with the Friends of Anahuac Refuge and the McFaddin and Texas Point Refuges Alliance, two citizen support groups, with state agencies such as the Texas Parks and Wildlife Department, the Texas General Land Office and the Galveston Bay Estuary Program, and with conservation organizations such as the Galveston Bay Foundation, Ducks Unlimited and local Audubon Society chapters have been highly successful. Volunteers on the Refuge Complex currently provide over 10,000 hours of service annually. In addition, the USFWS is working with private landowners to enhance or restore coastal marsh and prairie wetlands habitat on private lands, by providing technical assistance and helping to coordinate use of several private lands programs (such as the USFWS Partners for Fish and Wildlife Program and the multi-partner Texas Prairie Wetland Project). Many private lands in the region are skillfully managed to provide habitat for wintering waterfowl and other migratory birds.

Current USFWS community outreach and partnership activities:

- Maintain existing partnerships with the Friends of Anahuac Refuge and the McFaddin and Texas Point Refuges Alliance and conservation organizations such as the Galveston Bay Foundation, Ducks Unlimited and local Audubon Society chapters.
- Participate in partnership efforts with local and county governments, and state and federal agencies including the Texas Parks and Wildlife Department, Texas General Land Office, Galveston Bay Estuary Program, National Marine Fisheries Service and the U.S. Army Corps of Engineers to protect and enhance coastal natural resources.
- Maintain active refuge volunteer program on the Refuge Complex.
- Provide technical assistance to private landowners in Chambers, Jefferson and Galveston counties wishing to enhance wetland habitats for waterfowl and other wetland-dependent migratory birds through active management and restoration.
- Coordinate with private landowners in Chambers, Jefferson and Galveston counties to develop habitat enhancement and restoration projects through the USFWS Partners for Fish and Wildlife Program, and through other private lands programs such as the Texas Prairie Wetlands Project (a partnership program sponsored by Ducks Unlimited, Texas Parks and Wildlife Department, the Natural Resource Conservation Service, and the USFWS).

F. Administration and Staffing

Current staffing on the Refuge Complex includes 30 full-time positions and 2 seasonal positions. Staffing is complimented by programs such as the Student Career Enhancement Program, the Youth Conservation Corps program, and student interns during the summer field season. Current staffing levels are as follows:

Texas Chenier Plain Refuge Complex

Refuge Manager – Refuge Complex Project Leader

Refuge Complex Administrative Officer

Refuge Complex Law Enforcement Officer

Fire Management Officer

Assistant Fire Management Officer

Prescribed Fire Specialist

Range Technician – Fire Monitor

Range Technician – Fire Crew (5)

Anahuac NWR

Refuge Manager

Refuge Administrative Technician

Refuge Operations Specialist
Wildlife Biologist
Outdoor Recreation Planner
Outdoor Recreation Planner – Volunteer Coordinator
Maintenance Mechanic
Heavy Equipment Operator (2)
Maintenance Worker
Biological Technician – Seasonal

McFaddin NWR
Refuge Manager
Administrative Assistant
Wildlife Biologist
Biological Technician
Heavy Equipment Operator
Maintenance Worker
Biological Technician – Seasonal

Texas Point NWR
Refuge Manager

II. REFUGE MANAGEMENT ALTERNATIVE B - EMPHASIS ON INTENSIFYING MANAGEMENT OF WETLAND HABITATS FOR WATERFOWL, SHOREBIRDS, WADING BIRDS, AND OTHER WETLAND-DEPENDENT MIGRATORY BIRDS

Alternative B Concept

Management Focus

Under this Alternative, the Refuge Complex would focus its management efforts on active management of wetland and upland habitats to benefit waterfowl, shorebirds, wading birds, and other wetland-dependent migratory and resident birds. In marsh habitats, grazing intensity, annual prescribed burn acreage and the frequency of burning would be increased to substantially increase the amount of marsh habitat in early successional plant communities. Two new marsh semi-impoundments totaling 7,500 acres would be constructed and water management capabilities enhanced in existing impoundments through installation of new water control structures and levees. The cooperative rice farming program, moist soil management, mowing (and haying) programs on Anahuac NWR would be expanded to enhance shallow freshwater wetland habitats and adjacent upland prairies for resident Mottled Ducks, and for wintering and migrating waterfowl, shorebirds and wading birds. Management of native prairie and coastal woodlot habitats would focus on protecting existing prairie units and woodlots. Efforts to provide technical and financial assistance to private landowners through implementation of private lands initiatives to enhance waterfowl habitat on private lands would be expanded.

The Refuge Complex would also continue to provide and promote opportunities for all six of the National Wildlife Refuge System's priority wildlife-dependent recreational uses. Changes to the public waterfowl hunt program would include providing additional opportunity for waterfowl hunting and new hunting opportunities for additional species, more "assigned area" (spaced blind) hunting opportunities, and allowing commercially guided hunting on designated portions of the Refuge Complex. New wildlife observation and photography facilities would be developed to provide for additional opportunities to view wetland-dependent birds. Interpretive and environmental education programs and facility development would focus on habitat management activities in wetlands, and on conservation of waterfowl and other wetland-dependent migratory birds.

Three essential staffing positions would be added and filled to implement Refuge Management Alternative B, and would include a wildlife biologist, law enforcement officer, and heavy equipment operator.

Rationale for this Management Focus

The Texas Gulf Coast is the primary site for ducks wintering in the Central Flyway, with an average of 1.3-4.5 million birds, or 30-71% of the total Flyway population (Stutzenbaker and Weller 1989). This area also winters 90% of the snow, Canada, and greater white-fronted geese in the Central Flyway (Buller 1964). Additionally, the coastal marshes, prairies and prairie wetlands of the Chenier Plain region of the Texas Gulf Coast serve as a critical staging area for Central Flyway waterfowl migrating to and from Mexico and Central and South America. The Refuge Complex's coastal marshes host hundreds of thousands of wintering and migrating Central Flyway waterfowl, shorebirds, wading birds and other wetland dependent birds. Intensive management of Refuge Complex habitats is needed to help counter habitat changes over much of the region which have negatively impacted the quantity and quality of habitat for waterfowl and other migratory birds.

Alterations of historic hydrology including loss of freshwater inflows and increased saltwater intrusion, coastal erosion, land subsidence and sea level rise are contributing to ongoing coastal marsh loss and degradation, and these changes are negatively impacting habitat quality for many waterfowl species (Chabreck 1982, Stutzenbaker and Weller 1989). Recent trends in local agriculture have also decreased

the quantity and quality of available habitat for migrating and wintering waterfowl and other migratory birds. Acreage in rice production, which provides valuable freshwater wetland habitat for waterfowl, shorebirds and other migratory birds and freshwater inflows to estuaries, has declined significantly over the last decade in Jefferson and Chambers counties.

Under specific resources in the description of this Alternative and the following Alternatives, some USFWS management activities are described as being “*No Change from Refuge Management Alternative A*”. This means the USFWS would continue the management activities affecting that particular resource as already described in Refuge Management Alternative A, “Continuation of Current Management”. In other places, the USFWS management activities are described as “...would continue with additions and/or modifications” which means the management activities affecting that particular resource as already described in Refuge Management Alternative A would continue with the stated additions and/or modifications.

A. USFWS Habitat Management and Restoration

The primary focus of USFWS land management activities on the Refuge Complex is to fulfill the establishment purpose(s) for the Refuges, i.e., for the conservation and management of migratory birds and their habitats. Habitat management and restoration activities under Refuge Management Alternative B would emphasize enhancing wetland habitats to benefit waterfowl, shorebirds, wading birds, and other wetland-dependent migratory and resident birds. These activities would include water management, prescribed burning, controlled grazing, and mowing (and haying).

These habitat management activities focus on achieving the following two Refuge goals:

- GOAL 1. Conserve, enhance and restore the Texas Chenier Plain region’s coastal wetlands to provide wintering, migrational, and nesting/brood-rearing habitat for waterfowl, shorebirds, marsh and wading birds, other wetland-dependent birds, and habitat for other native fish and wildlife.
- GOAL 2. Conserve, enhance and restore the Texas Chenier Plain region’s coastal prairies and coastal woodlands to provide wintering, migrational, and nesting habitat for resident and migratory landbirds, including neotropical/heartic migratory birds, and habitat for other native wildlife species.

1. Wetland Specific Management and Restoration

Water management activities (e.g. structural management of water levels and salinities and freshwater inflows) impact the Refuge Complex’s hydrologic regime and strongly influence wetland plant communities. Managed marsh units within the Refuge Complex are under varying degrees of structural control, and may be best described as marsh semi-impoundments. Some units are entirely or almost entirely behind man-made levees and water control structures, and are intensively managed through manipulation of the water control structures. Most are managed less intensively, relying to some degree on natural topography and drainage to control hydrologic regimes. Structural water management allows maintenance of the historic continuum of fresh, intermediate, brackish and saline marshes on the Refuge Complex.

a. Emergent Wetlands

The objective for Emergent Wetlands (Estuarine and Palustrine) under Refuge Management Alternative B is to establish, manage and maintain 60 to 70% of fresh and intermediate emergent coastal marshes on the Refuge Complex in target plant communities which contain several early successional plant species. Habitat values for waterfowl, shorebirds and many wading bird species are greatly enhanced in fresh and intermediate marshes with early successional plant communities containing several perennial and annual plant species (primarily grasses and sedges) which provide important food resources, and where disturbance reduces the height and/or density of vegetation. [See I.A.1.a. *Emergent Wetlands* for a description of successional emergent plant species]. In addition to water level and salinity management, prescribed burning and controlled grazing are available tools for influencing plant communities (species

composition and physical structure) in marsh habitats. The use of these management tools would be expanded and/or intensified under this Alternative to increase the number of acres of emergent marsh habitats with target plant communities.

USFWS management activities for emergent wetlands in Refuge Management Alternative A would continue, with the following modifications and additional activities:

- Construct a 1,500-acre marsh semi-impoundment with levees and water control structures on the Deep Marsh Unit of Anahuac NWR
- Construct a 5,000-acre marsh semi-impoundment with levees and water control structures in the Dipping Vats Management Unit of McFaddin NWR.
- Conduct a rotational prescribed burning program in emergent marsh habitats on the Refuge Complex, with an annual burning objective of 35,000 acres.
- Conduct annual prescribed burning in selected fresh and intermediate marsh units which are key waterfowl habitats.
- Increase current grazing intensity (stocking rates and duration) in all grazing units containing fresh and intermediate marshes on the Refuge Complex.
- Increase herbivory by native wildlife by developing new grit sites and maintaining sanctuary areas for geese through the special white goose conservation season (in effect since 1999) which follows the regular waterfowl season.

b. Open Water Wetlands (Estuarine and Palustrine)

The objective for Open Water Wetlands (Estuarine and Palustrine) is to increase species diversity and production of submerged aquatic vegetation in marsh habitats and increase open water habitat by 10% in fresh and intermediate marshes on the Refuge Complex. The submerged aquatic plant community serves as a direct source of important waterfowl foods (e.g., seeds and tubers), and indirectly, as a rich environment for aquatic macroinvertebrates, which are heavily utilized by waterfowl and many other wetland birds (Baldassarre and Bolen 1994). [See I.A.1.b. *Open Water Wetlands (Estuarine and Palustrine)* for further explanation of submerged aquatic vegetation and competing vegetation]. Water level and salinity management within marsh semi-impoundments are important tools for restoring and maintaining submerged aquatic vegetation production and species diversity. Construction of marsh terraces in larger open water wetlands to reduce wave fetch and turbidity can promote the establishment and growth of submerged aquatic vegetation.

USFWS management activities for open water wetlands in Refuge Management Alternative A would continue, with the following modifications and additional activities:

- On Anahuac NWR, improve water level management capabilities in Shoveler Pond, Rail Reservoir, Moccasin Pond, Otter Pond, and East Unit South Reservoir of Anahuac NWR by modifying existing and installing new water control structures.
- On McFaddin NWR, enhance water level and salinity management in Wild Cow Bayou Management Unit by installing additional water control structures along the GIWW and rehabilitating levees (LeBlanc's Reservoir, Pond 11, Pond 13), and modifying the existing western levee system to prevent saltwater intrusion.
- On McFaddin NWR, enhance water management in Willow and Barnett Lake units of McFaddin NWR through design and construction of new water control structures along the GIWW.
- On McFaddin NWR, enhance water management in Willow Slough (North Unit of McFaddin NWR) through design and construction of new water control structures/spillways and associated management infrastructure.
- On McFaddin NWR, construct marsh terraces to reduce fetch and turbidity and increase production of submerged aquatic vegetation in Willow/Barnett Lake area and Ponds 28 and 29 on McFaddin NWR, and as needed in open water areas on Texas Point NWR and Anahuac NWR.
- Throughout the Refuge Complex, implement an integrated control program for common reed, cattail and other emergent plants resulting in loss of open water habitats using herbicide application, mechanical removal, salinity control, prescribed burning and controlled grazing on selected units including the Deep Marsh, East Unit and Middleton Tract units of Anahuac NWR,

and the White's Fee, Wild Cow Bayou, White's Pasture and North Unit of McFaddin NWR. Expand control efforts over the life of the CCP using the most effective strategies.

- Develop enhanced Geographic Information System capabilities to monitor status and trends of wetlands on all four refuges in the Refuge Complex. Use GIS technology, remote sensing, LIDAR surveys and other tools to map micro-topography and define watersheds, quantify water usage, and detect trends in open water to emergent marsh ratios and large-scale vegetative changes.
- Facilitate and support a research study to identify causative factors of the "black water phenomenon" which negatively impacts submerged aquatic vegetation production in marsh habitats, and to guide development of adaptive management strategies to prevent or minimize these impacts.

c. Freshwater Prairie Wetlands (Palustrine)

The objective for Freshwater Prairie Wetlands (Palustrine Emergent) is to maintain 2,400 to 2,800 acres of managed and natural shallow freshwater wetlands on the Refuge Complex, and to actively manage adjacent prairie habitats to improve nesting habitat for Mottled Ducks and other ground nesting migratory birds. A large portion of the upper Texas Coast prairie habitats have been cultivated for rice production, which provides valuable habitat for waterfowl, shorebirds, and many other migratory birds (Hobaugh *et al.* 1989, Wilson 2001). However, rice production has declined significantly during the last decade in counties surrounding the Refuge Complex, reducing available prairie wetland habitat for waterfowl, shorebirds and other wetland-dependent species. Mottled Ducks heavily utilize prairie habitats adjacent to freshwater wetlands for nesting (Stutzenbaker 1988).

USFWS management activities proposed to achieve this objective for freshwater prairie wetlands:

- Increase rice acreage in Anahuac NWR cooperative farming program to 800 to 1,200 acres per year (an increase of 300-500 acres over current levels).
- Increase moist soil management on the Refuge Complex by 1,100 acres annually, to a total of 1,600 acres. Develop an additional 900 acres (to a total of 1,400 acres) of moist soil units on the Anahuac NWR (400 acres on the Old Anahuac Unit, 400 acres on the East Unit, and 100 acres on the Middleton Tract Unit), and develop 200 acres of moist soil units on McFaddin NWR.
- Provide migrational habitat for shorebirds annually during spring and fall on 300 acres of moist soil units on Anahuac NWR.
- Mow and/or hay 400 acres of transitional wet prairie annually on Anahuac NWR to enhance migrational and wintering habitat for waterfowl and shorebirds.
- Create shallow freshwater wetland habitat in selected dredge disposal sites along the GIWW on McFaddin NWR by installing levees and water control structures during the next maintenance dredging cycle. This will involve a cooperative project with the U.S. Army Corps of Engineers.

2. Upland Specific Management and Restoration

a. Native Prairie and other Grasslands

The objective for native prairie and other grasslands is to protect and manage the 5,744 acres of non-saline grasslands on the Refuge Complex, including "prairie remnants", permanently fallowed former croplands which are naturally revegetating, and sites previously restored to native prairie using intensive restoration techniques. Prescribed burning, controlled grazing, mowing (and haying) and invasive plant control would be the primarily management tools employed.

No Change from Refuge Management Alternative A, except that no additional native coastal prairie will be restored on Anahuac NWR using intensive restoration techniques.

b. Coastal Woodlands

The objective for Coastal Woodlands is to protect and enhance the existing 127 acres of woodland habitats on the Refuge Complex.

No Change from Refuge Management Alternative A.

B. USFWS Biological Program – Surveys, Monitoring, and Research

The USFWS habitat management and restoration activities benefit many species of native fish, wildlife and plants on the Refuge Complex. The USFWS biological program on the Refuge Complex includes monitoring, field surveys and research studies of fish and wildlife population status, population trends and habitat utilization. The information obtained allows the USFWS to adapt management efforts on the Refuge Complex as needed to achieve Refuge purposes and to maintain and restore biological integrity and biological diversity. Data are also used in support of international, national and regional conservation initiatives.

These wildlife conservation efforts focus on achieving the following Refuge goal:

- GOAL 3. A comprehensive biological program will guide and support conservation efforts for all species of native fish, wildlife and plants on the Texas Chenier Plain Refuge Complex.

1. Waterfowl, Shorebirds, and other Wetland-Dependent Migratory Birds

The biological program objective for waterfowl, shorebirds and other wetland-dependent migratory birds is to help maintain healthy populations of species utilizing the Refuge Complex, and to document population status and trends and habitat utilization of priority species. Coastal habitats of the Texas Chenier Plain region provide important wintering and migrating habitat for waterfowl of the Central Flyway, and for millions of shorebirds, wading birds, colonial nesting waterbirds, and other wetland-dependent migratory birds. Monitoring and studies of population trends and habitat utilization provide information to assess management activities on the Refuge Complex. Data are also used in support of international, national and regional migratory bird conservation initiatives.

No change from biological program activities in Refuge Management Alternative A. USFWS biological program activities supporting conservation of waterfowl, shorebirds, and other wetland-dependent migratory birds in Refuge Management Alternative A would continue.

The objective for Mottled ducks, an important resident waterfowl species, is to increase breeding pair densities in suitable habitats on the Refuge Complex to at least 11 breeding pairs per square mile (the 15-year average for the period 1988-2002); and, to gather additional information on the factors impacting Mottled Duck populations through applied research and monitoring. Both spring breeding pair and September aerial surveys conducted by the USFWS indicate a steady decline in Mottled Duck populations on coastal national wildlife refuges in Texas over the last 16 years. While drought conditions along much of the Texas Coast during late 1990's undoubtedly contributed to this decline, other potential causative factors include loss of freshwater wetlands and upland nesting habitat due to land use changes, loss of pair bond, brood rearing and molting habitats due to invasive plant encroachment in open water habitats, brush encroachment in nesting habitats, increased predation by alligators, mammalian predators and fire ants, and lead shot ingestion rates that have remained high in some areas.

USFWS biological program and management activities for Mottled Ducks described in Refuge Management Alternative A would continue. Proposed additional USFWS biological program and management activities supporting conservation of Mottled Ducks include:

- Expand and refine annual Mottled Duck breeding pair index survey on the Refuge Complex to include an assessment of Mottled Duck use by habitat type (fresh, intermediate, and brackish marshes).

- Facilitate and support new research including studies to: 1) evaluate Mottled Duck nesting success and brood survival and identify factors affecting these vital rates; 2) determine habitat utilization and preferences during nesting, brood rearing, and molting periods; and 3) evaluate effects of predation by alligators, mammalian predators and fire ants on Mottled Duck survival. This would include removing alligators and mammalian predators from key Mottled Duck brood-rearing habitats, and assessing impacts on nest success and duckling survival.
- Manage 400 acres of moist soil units annually on Anahuac NWR specifically to provide brood-rearing habitat for Mottled Ducks during summer.
- Enhance management capabilities for Mottled Ducks on 300 acres of freshwater impoundments within the Wild Cow Bayou Management Unit on McFaddin NWR by rehabilitating existing levees and installing new water control structures. Intensively manage approximately 400 hundred acres of marsh habitat located adjacent to freshwater impoundments as optimum brood-rearing habitat.
- Develop and maintain at least two grit sites for Mottled Ducks within the Wild Cow Bayou Management Unit of McFaddin NWR.
- Restore pair pond and brood rearing habitats in key management units on the Refuge Complex (those currently supporting breeding Mottled Ducks) by restoring open water habitats lost to invasive plant encroachment, using an integrated approach (an intensified program involving prescribed burning, controlled grazing, water level and salinity management, mechanical removal, and spot herbicide treatments).
- Provide additional open, shallow freshwater habitat in and adjacent to key management units (those currently supporting breeding Mottled Ducks).
- Maintain optimal nesting cover in salty prairie habitats by applying prescribed fire and grazing at designated frequencies and intensities, based on ongoing site-specific assessments. Manage fire occurrence in salty prairie and other optimum nesting cover using mowed green fire breaks and other innovative techniques.

2. Migratory and Resident Landbirds

The biological program objective for migratory and resident landbirds is to help maintain healthy populations of species utilizing the Refuge Complex, and to document population trends, status and habitat utilization of priority species. Monitoring and study of population trends and habitat utilization provides information used to assess and improve management activities on the Refuge Complex. Data are also used in support of international, national and regional migratory bird conservation initiatives.

No Change from biological program activities in Refuge Management Alternative A.

3. Fish and other Aquatic Species

The biological program objective for fish and other aquatic species is to ensure healthy populations and document population trends, status and habitat utilization of priority species on the Refuge Complex. A second objective is to incorporate fisheries and aquatic resource management into the management of all estuarine marshes on the Refuge Complex.

No Change from biological program activities in Refuge Management Alternative A.

4. Threatened and Endangered Species, Species of Conservation Concern

The biological program objective for Threatened and Endangered species, Species of Conservation Concern, and other “watch species” is to support recovery efforts and to obtain information on population trends, status and habitat utilization of sensitive and/or declining species utilizing the Refuge Complex. Eight federally-listed Threatened and Endangered species occur on or adjacent to the Refuge Complex: Bald Eagle, Piping Plover, Brown Pelican, Loggerhead sea turtle, Kemp’s Ridley sea turtle, Green sea turtle, Hawksbill sea turtle, and Leatherback sea turtle.

No Change from biological program activities in Refuge Management Alternative A.

5. Mammals

The biological program objective for mammals is to maintain healthy populations and to document population trends, status and habitat utilization of priority species on the Refuge Complex.

No change from biological program activities in Refuge Management Alternative A.

6. Reptiles and Amphibians

The biological program objective for reptiles and amphibians is to maintain healthy populations and natural diversity, and to document population status and trends. The objective for Alligators is to maintain alligator populations at self-sustaining levels, but at densities consistent with migratory bird management objectives.

No change from biological program activities in Refuge Management Alternative A.

7. Invertebrates

The biological program objective for invertebrates is to maintain healthy populations and natural diversity, and document species occurrence on the Refuge Complex.

No change from biological program activities in Refuge Management Alternative A.

8. Plant Resources

The biological program objective for plant resources is to maintain native plant species diversity and to document native species composition and plant community changes over time on the Refuge Complex.

No change from biological program activities in Refuge Management Alternative A.

C. Addressing Threats to the Ecosystem

The USFWS has ongoing efforts on the Refuge Complex to address threats to ecosystem health posed by relative sea level rise, hydrological alternations, exotic species, and contaminants. These include coordination with other agencies and conservation organizations on ongoing planning processes and studies aimed at developing solutions to address coastal land loss along the Gulf of Mexico, and to implement small-scale erosion abatement projects along the Gulf, Galveston Bay, and the Gulf Intracoastal Waterway.

These efforts addressing threats to ecosystem health focus on achieving the following Refuge goal:

- GOAL 4. By working with others locally and on a landscape level, threats to natural biological diversity, ecological integrity, and environmental health on the Texas Chenier Plain Refuge Complex will be addressed.

For addressing threats posed by Relative Sea Level Rise and Reduced Sediment Supply, Altered Hydrologic Processes, Invasive Species, Contaminants, and for managing New Oil and Gas Development, there would be no change from USFWS activities in Refuge Management Alternative A.

D. USFWS Public Use Program

The Texas Chenier Plain Refuge Complex offers a wide variety of recreational opportunities and received over 172,000 visitors during Fiscal Year 2002. Through the use of existing programs and facilities, the Refuge Complex provides opportunities for all six of the Refuge System's priority wildlife-dependent recreational uses, which are:

- Hunting

- Fishing
- Wildlife Observation and Photography
- Environmental Education and Interpretation

These visitor and recreational opportunities focus on achieving the following Refuge goal:

- GOAL 5. All local, national and international visitors will enjoy safe and high quality outdoor experiences on the Refuge Complex, and learn of the Refuge Complex' role in conserving the region's coastal natural resources. New partnerships with our local communities will be forged to highlight, promote and conserve the unique natural assets of the upper Texas Gulf Coast.

1. Hunting

The objective for hunting is that, within 15 years, 90% of all hunting visits on the Refuge Complex will qualify as high-quality hunting experiences, as determined by surveys of hunters conducted at the waterfowl check stations. Under this Alternative, intensified management of wetland habitats for waterfowl will increase wintering waterfowl populations on the Refuge Complex. Additional hunting opportunities for waterfowl and other game species could be provided. Crowding in the more accessible or "best" hunting spots is a major factor impacting hunt quality on the Refuge Complex. Converting the most accessible hunt units from an unrestricted entry to an "Assigned Area" program would help alleviate the crowding problem.

Current USFWS public use program activities in support of hunting in Refuge Management Alternative A would continue, with the following changes:

- On Anahuac NWR, modify the East Unit hunt program to an "Assigned Area" program for the entire unit, and establish a new Assigned Area program on the Middleton Tract hunt unit.
- Open the Anahuac NWR East Unit to hunting during the September teal season.
- On McFaddin NWR, establish new "Assigned Area" programs on the Star Lake, 5-mile Cut, and Clam Lake hunt areas.
- Open a designated portion of McFaddin NWR to seven-day per week waterfowl hunting.
- Open the Refuge Complex to snipe, rail, and gallinule hunting.
- Establish a guided hunt program (concession with commercial outfitter) on the designated portions of the Anahuac and McFaddin NWRs.
- Open Anahuac NWR for dove hunting in designated area(s) in cooperation with the Texas Parks and Wildlife Department.

2. Fishing

The objective for fishing is that, within 15 years, 90% of all fishing visits on the Refuge Complex will qualify as high-quality fishing experiences, as determined by angler comments documented during routine visitor contacts.

Current USFWS public use program activities in support of fishing in Refuge Management Alternative A would continue, with the following changes:

- Extend the open hours on McFaddin NWR (designated areas accessible from Clam Lake Road) to one hour before sunrise to one hour after sunset on weekdays, and open this portion of the Refuge on weekends.

3. Wildlife Observation and Photography

The objective for wildlife observation and photography is that, within 15 years, several new facilities will be developed to increase opportunities to view and photograph waterfowl, shorebirds and other wetland-dependent migratory birds in managed wetland habitats. Because overall management of the Refuge Complex under this Alternative will emphasize wetland habitat management, new wildlife viewing and photography opportunities should be developed in managed habitats such as marsh semi-impoundments, rice fields and moist soil units for waterfowl, shorebirds and other wetland-dependent migratory birds.

Current USFWS public use program activities in support of wildlife observation and photography in Refuge Management Alternative A would continue, with the development of the following additional facilities:

- Construct a new observation platform overlooking the Anahuac NWR Oyster Bayou Moist Soil units.
- Construct a tree-canopy height observation platform on the Anahuac NWR East Bay Bayou Trail, overlooking the rice and moist soil units.
- Develop a levee trail, boardwalk for wildlife observation and photography blind near the Refuge Headquarters on McFaddin NWR.
- Develop a connecting trail, boardwalk and observation platform on Texas Point NWR.

4. Environmental Education and Interpretation

The objective for environmental education and interpretation is that, within 15 years, 90% of visitors will feel that they have increased their knowledge of wetland management programs and wetland-dependent migratory birds found on the Refuge Complex. Because overall management of the Refuge Complex under this Alternative will emphasize intensified management of wetland habitats, educational and interpretive programs and materials would focus on managed habitats, management techniques, and wetland-dependent fish and wildlife resources.

Current USFWS public use program activities in support of environmental education and interpretation in Refuge Management Alternative A would continue, with the development of the following additional facilities and programs:

- On Anahuac NWR, develop interpretive exhibits on wetland and upland habitat management practices including prescribed burning, controlled grazing, water management and exotic species control and strategically place throughout the Refuge.
- Develop interpretive exhibits on waterfowl for the Anahuac NWR East Unit Hunter Check Station.
- Develop a Refuge Complex brochure on the role of fire management in enhancing marsh and upland habitats for waterfowl.
- Develop interpretive signs for the Anahuac NWR Oyster Bayou Moist Soil Unit overlooks.
- On Anahuac NWR, conduct weekly winter interpretive walks, focusing on wintering waterfowl and the habitats they utilize.
- Develop a Refuge Complex mobile interpretive display focusing on intensive management techniques used to support waterfowl, shorebirds, and other wetland-dependent migratory birds.
- Develop interpretive exhibits on wetland and upland habitat management practices including prescribed burning, controlled grazing, water management and exotic species control and strategically place throughout the Refuge Complex.
- Develop interpretive exhibit on waterfowl for the McFaddin NWR check station.
- Conduct monthly fall and winter waterfowl identification programs, utilizing new observation platforms on McFaddin and Texas Point NWRs.
- Produce a slide show emphasizing the importance of each Refuge in conserving coastal natural resources, emphasizing waterfowl, shorebirds and wetland-dependent migratory birds and their habitats.
- Develop videos describing wetland habitat management programs and how they enhance habitat for wetland-dependent migratory birds.
- Revise each general brochure and website to emphasize each Refuge's role in managing for waterfowl, shorebirds, and other wetland-dependent species.

5. Beach Uses on McFaddin NWR

The objective for beach uses on McFaddin NWR is to protect public safety and natural resources along the Gulf of Mexico shoreline within the refuge.

No change from USFWS law enforcement activities to protect public safety and natural resources on McFaddin NWR in Refuge Management Alternative A.

E. Community Outreach and Partnerships

The objective for community outreach and partnerships is to promote conservation of natural resources by working effectively with partners in support of USFWS management programs on the Refuge Complex including habitat management and restoration, fish and wildlife population management, and providing public recreational and educational opportunities. Partnerships with the Friends of Anahuac Refuge and the McFaddin and Texas Point Refuges Alliance, two citizen support groups, with state agencies such as the Texas Parks and Wildlife Department, the Texas General Land Office and the Galveston Bay Estuary Program, and with conservation organizations such as the Galveston Bay Foundation and local Audubon Society chapters have been particularly effective. Volunteers on the Refuge Complex provide over 10,000 hours of service annually. In addition the USFWS is working with private landowners to enhance or restore coastal marsh and prairie wetlands habitat on private lands, by providing technical assistance and helping to coordinate use of several private lands programs (such as the USFWS Partners for Fish and Wildlife Program and the multi-partner Texas Prairie Wetland Project). Many private lands in the region are skillfully managed to provide habitat for wintering waterfowl and other migratory birds. The objective for Private Lands Partnerships is that, within 15 years, 1,500 acres of coastal marsh and prairie wetlands habitat on private lands in the Texas Chenier Plain region will be enhanced or restored through coordination with interested private landowners and the use of USFWS private lands programs. Many private lands in the region are skillfully managed to provide habitat for wintering waterfowl and other migratory birds. A variety of private lands programs are available to private landowners, and there is widespread interest in managing for waterfowl.

Current USFWS community outreach and partnership activities in Refuge Management Alternative A would continue, with the following efforts to expand partnerships with private landowners to enhance wetland habitats:

- Hold three on-refuge workshops for private landowners and other agency personnel to demonstrate marsh management and restoration, moist soil management, and other wetland management techniques, and to highlight available USFWS private lands programs and grant opportunities.
- Increase coordination with private landowners in Chambers, Jefferson and Galveston counties to develop habitat enhancement and restoration projects through the USFWS Partners for Fish and Wildlife Program, and through other private lands programs such as the Texas Prairie Wetlands Project (a partnership program sponsored by Ducks Unlimited, Texas Parks and Wildlife Department, the Natural Resource Conservation Service, and the USFWS).

F. Administration and Staffing

In addition to the existing Refuge Complex staff positions under Refuge Management Alternative A, three essential staffing positions would be filled to implement Refuge Management Alternative B:

- Wildlife biologist
- Law enforcement officer
- Heavy equipment operator

III. REFUGE MANAGEMENT ALTERNATIVE C – EMPHASIS ON NATIVE HABITAT RESTORATION AND ADDRESSING MAJOR THREATS TO THE ECOSYSTEM

Alternative C Concept

Management Focus

Under this Alternative, the Refuge Complex would focus its management efforts on restoring wetlands, native prairie and woodlots, and on reversing trends of loss and degradation of these native habitats by increasing efforts to address coastal erosion, saltwater intrusion, and loss of freshwater and sediment inflows. Restoration of native prairie and prairie wetlands would occur on all suitable upland sites. Areas currently or formerly in rice cultivation on Anahuac NWR would be restored to native prairie and shallow depressional prairie wetlands. Controlled grazing and prescribed burning programs would be substantially modified. Controlled cattle grazing in marsh units would occur at reduced intensity, and be timed to follow prescribed burns or wildland fires. The frequency of prescribed burning would decrease in marsh habitats, and the primary timing of prescribed burning activities would shift from fall and winter to spring and summer to mimic the historic fire regime. Controlled grazing and prescribed burning in upland prairie habitats would include more short duration, high intensity grazing episodes and increased spring and summer burning.

A portion of the historic fresh and intermediate component of the Refuge Complex's coastal marshes would be restored and ongoing interior marsh loss addressed by working with agencies and other stakeholders on major hydrologic restoration projects that restore freshwater inflows and further restrict saltwater intrusion across watersheds, and through refuge-specific projects.

Following completion of watershed hydrologic restoration projects, intensive water level and salinity management in selected marsh semi-impoundments through active manipulation of water control structures would be replaced by more passive hydrological management using rock weirs. Efforts to address coastal wetland loss resulting from shoreline erosion along the Gulf, Galveston Bay and the GIWW would be intensified by increasing coordination among agencies and other stakeholders to develop and implement major projects aimed at stabilizing shorelines, and by implementing smaller scale projects on the Refuge Complex. Restoring sediment supply to the Gulf's near shore littoral zone, restoration of the Gulf beach/dune complex and under shore marshes on Galveston Bay, and stabilizing the banks of the GIWW would be the focus of USFWS efforts. Control and monitoring programs for invasive species would be intensified, and additional efforts to monitor and reduce impacts of contaminants implemented.

The Refuge Complex would continue to provide the current level of opportunities for all six of the National Wildlife Refuge System's priority wildlife-dependent recreational uses: hunting, fishing, wildlife observation and photography, and environmental education and interpretation. No changes in administration of the public waterfowl hunt program would be implemented. New wildlife observation and photography facilities would be developed for viewing wildlife in restored habitats. Interpretive and environmental education programs and facility development would focus on interpreting native habitats and native biological diversity, threats to ecosystem integrity, and habitat restoration techniques and projects.

Rationale for this Management Focus

The coastal marshes, prairies and woodlots of the Chenier Plain region of southwestern Louisiana and southeast Texas comprise a hemispherically important biological area. The Refuge Complex' coastal marshes host hundreds of thousands of wintering and migrating Central Flyway waterfowl, shorebirds, wading birds and other wetland-dependent migratory birds. Coastal prairie and coastal woodlots on the Refuge Complex support over 150 migratory and resident land bird species, including 9 species of

grassland birds and 7 species utilizing woodland habitats listed as Rare and Declining within the Coastal Prairies Region in Texas (Texas Parks and Wildlife Department 2000). Overall, wetland, prairie and woodland habitats on the Refuge Complex provide habitat for 33 Avian Species of Conservation Concern in the Gulf Prairies Bird Conservation Region.

The high degree of alteration in this ecosystem has resulted in loss and degradation of native habitats and loss of biological diversity. Alterations of historic hydrology including loss of freshwater inflows and increased saltwater intrusion, coastal erosion, land subsidence and sea level rise are contributing to ongoing coastal marsh loss and degradation. Almost all of the region's historic native tallgrass coastal prairie and its associated prairie wetlands have disappeared, and remaining coastal woodlots are imminently threatened by development and other land use changes. Several highly invasive exotic plant species are replacing native habitats and severely impacting native biological diversity. Air and water quality issues in the region pose a potential contaminant threat to fish and wildlife, as do accidental spills and discharges from the major petrochemical shipping, storage and processing facilities located in close proximity to sensitive wetland habitats on the Refuge Complex.

A. USFWS Habitat Management and Restoration

The primary focus of USFWS land management activities on the Refuge Complex is to fulfill the establishment purpose(s) for the Refuges, i.e., for the conservation and management of migratory birds and their habitats. Under Refuge Management Alternative C, the USFWS would emphasize restoration of wetlands, native prairie and woodlots, and reversing trends of loss and degradation of these native habitats by increasing efforts to address the effects of relative sea level rise and reduced sediment supply, altered hydrologic processes, exotic and invasive species and environmental contaminants.

Habitat management and restoration activities would focus on achieving the following two refuge goals:

- GOAL 1. Conserve, enhance and restore the Texas Chenier Plain region's coastal wetlands to provide wintering, migrational, and nesting/brood-rearing habitat for waterfowl, shorebirds, marsh and wading birds, other wetland-dependent birds, and habitat for other native fish and wildlife.
- GOAL 2. Conserve, enhance and restore the Texas Chenier Plain region's coastal prairies and coastal woodlands to provide wintering, migrational, and nesting habitat for resident and migratory landbirds, including neotropical/nearctic migratory birds, and habitat for other native wildlife species.

1. Wetland Specific Management and Restoration

Water management activities (e.g. structural management of water levels and salinities and freshwater inflows) impact the Refuge Complex's hydrologic regime and strongly influence wetland plant communities. Managed marsh units within the Refuge Complex are under varying degrees of structural control, and may be best described as marsh semi-impoundments. Some units are entirely or almost entirely behind man-made levees and water control structures, and are intensively managed through manipulation of the water control structures. Most are managed less intensively, relying to some degree on natural topography and drainage to control hydrologic regimes. Structural water management allows maintenance of the historic continuum of fresh, intermediate, brackish and saline marshes on the Refuge Complex.

a. Emergent Wetlands and Open Water Wetlands (Estuarine and Palustrine)

The objective for emergent and open water wetlands (Estuarine and Palustrine) under this Alternative is to maintain a mosaic of plant communities and successional stage marsh habitats primarily through natural disturbance events such as wildfire and herbivory by native wildlife. The USFWS would work with partner agencies to restore hydrology on a watershed scale, allowing scaling back some water management infrastructure to more passive infrastructure like rock weirs. Prescribed burning and grazing will be applied when needed to mimic the historic disturbance frequency and extent. Meeting the habitat needs of the region's diverse group of wetland-dependent avian species requires maintaining a diversity

of plant communities within marshes. Historically, disturbance events such as wildfire and herbivory by native wildlife (bison in particular) helped maintain this diversity. Although the historic fire frequency for the Chenier Plain marshes is unknown, we are assuming that these habitats historically burned at least every 2-4 years based on the region's high frequency of lightning strikes and long growing seasons which produce fuels capable of carrying fire in a single year. Allowing natural wildfire starts to burn (where practical) followed by controlled cattle grazing most closely replicates the historic disturbance regime; however, prescribed burning will probably be necessary to complete the historic 2-4 year burn frequency. Varying timing and frequency of prescribed burns within marsh units increases plant community diversity (Fredrickson and Reid 1990).

USFWS management activities proposed to achieve this objective for emergent and open water wetlands:

- Upon completion of major hydrologic watershed-scale restoration projects, replace structural management infrastructure in selected marsh semi-impoundments on the Refuge Complex with more passive hydrological control using rock weirs.
- Where feasible, utilize natural lightning starts to accomplish burning objectives by allowing natural wildfires to burn within Refuge Complex boundaries until they naturally extinguish.
- Conduct a rotational prescribed burning program in emergent marsh habitats with an annual burning objective of 5,000 to 6,000 acres annually. Integrate prescribed burning location and frequency with natural fire occurrences.
- Apply controlled cattle grazing in marsh units only in recently burned areas, at reduced intensity and only from October through April.

b. Freshwater Prairie Wetlands (Palustrine)

The objective for freshwater prairie wetlands (Palustrine) is to, within 15 years, create or restore 500 acres of shallow freshwater prairie "pothole" wetlands to reduce impacts of discontinuing the Anahuac NWR cooperative rice farming program, and maintain 500 acres of shallow freshwater wetlands annually using moist soil management. Loss of palustrine emergent wetlands has been the most pronounced among all coastal wetland types on the Texas Coast (Moulton *et al.* 1997). These wetlands provided extremely valuable habitat for many species of migratory birds and other native wildlife. Very few natural prairie wetlands remain on or adjacent to the Refuge Complex. Moist soil management also provides valuable shallow freshwater wetland habitat. The cooperative rice farming program would be phased out under this Alternative, resulting in a loss of 500-700 acres of farmed freshwater wetland habitat.

USFWS management activities proposed to achieve this objective for freshwater prairie wetlands:

- On Anahuac NWR, and restore approximately 500 acres of shallow depressional "pothole" prairie wetlands in the following management units: East Unit -300 acres, Granberry – 92 acres, Onion Bayou Prairie – 17 acres, East Bay Bayou Tract – 32 acres, and Middleton Tract – 60 acres.
- On Anahuac NWR, maintain moist soil management acreage at 500 acres annually.

2. Upland Specific Management and Restoration

a. Native Prairie and other Grasslands

The objective for native prairie and other grasslands is to protect and manage all of the 5,744 acres of non-saline grassland habitats on the Refuge Complex, including "prairie remnants", permanently fallowed former croplands which are naturally revegetating, and sites previously restored to native prairie using intensive restoration techniques. Prescribed burning, controlled grazing, mowing (and haying) and exotic/invasive plant control would be the primarily management tools employed. A second objective is to within 15 years, restore 4,535 acres of former cropland on Anahuac NWR to native prairie using intensive restoration techniques. Of the five Refuge Management Alternatives, the most extensive native prairie restoration would occur under this Alternative.

It is now estimated that 99.8% and 99.6 % of little bluestem and eastern gamma grass/switch grass prairies, respectfully, have been lost in Texas (McFarland 1995). Nine of the 13 avian species listed as

Rare and Declining within the Coastal Prairies Region in Texas (Texas Parks and Wildlife Department 2000) are present in grasslands on the Refuge Complex. In 2005, the USFWS listed 7 avian species occurring in prairie habitats on the Refuge Complex as Species of Conservation Concern in the Gulf Prairies Bird Conservation Region. Topography, soils, fire and grazing and trampling actions of herbivores, all in association with climate, are natural functions controlling grassland development. The use of prescribed fire, grazing, mowing, and herbicides at different sites with varying soil moisture can produce the variety of habitats needed to support a diverse prairie avifauna (Ryan 1990). Restoration of native prairie, an integrated management approach utilizing prescribed fire, exotic plant control, and controlled grazing is needed on the Refuge Complex to provide large blocks of nesting and wintering habitat for prairie-dependent avian and other wildlife species.

Current USFWS management activities to achieve objectives for native prairie and other grassland habitats would continue as in Refuge Management Alternative A. Proposed modifications and additional activities include:

- On Anahuac NWR, following phase out cooperative rice farming program, restore 2,312 acres of fallowed cropland and associated infrastructure on the East Unit to native prairie using intensive restoration techniques.
- On Anahuac NWR, restore an additional 2,223 acres of native prairie using intensive restoration techniques on the following management units: Gator Marsh – 97 acres, North Gator Marsh – 204 acres, Longtom Prairie – 186 acres, Pintail Marsh – 120 acres, Airstrip Prairie and East Bay Bayou Marsh – 1,000 acres, Middleton – 370 acres.
- Construct a 5-acre native prairie grass propagation area on the East Unit to increase native grass seeds for use in the prairie restoration program.
- Modify the controlled grazing program on upland prairie units to include more short-duration/high-stocking rate grazing episodes.
- Continue to conduct prescribed burns in prairie units in the spring, and initiate limited summer burning to help control invasive and exotic woody vegetation.

b. Coastal Woodlands

The objective for coastal woodlands is to, within 15 years, create 29 acres of new coastal woodlots on the Refuge Complex, and protect and diversify the 127 acres of existing woodlots and riparian woodlands. Coastal woodlots in the Chenier Plain region are extremely important to migrating songbirds (Rappole 1974, Sprunt 1975, Mueller 1981). Refuge Complex woodlands mark the first landfall for hundreds of thousands neo-tropical migratory birds making the trans-Gulf flights from Mexico, Central and South America during the spring migration. These birds spend one to several days in woodlands resting and foraging to help replenish fat reserves before continuing their migration to breeding habitats. During the fall migration, coastal woodlots provide the last opportunity for trans-Gulf migrants to increase their fat levels necessary for crossing the Gulf of Mexico (Caldwell *et al.* 1963). Migrant landbirds made greater use of woodlots with larger trees and denser under stories (Mueller and Sears 1987). Increasing the quality of habitat in Refuge Complex woodlots for migratory landbirds requires removing exotic plants and increasing under story density and species diversity.

Current USWS management activities to achieve objectives for coastal woodlands would continue as in Refuge Management Alternative A. Proposed additional activities include:

- On Anahuac NWR, create two 1-acre woodlots, one near the VIS and one at the Volunteer housing area. Create a 27-acre woodlot (green tree reservoir) on the East Unit along East Bay Bayou.
- Increase feral hog control efforts.

B. USFWS Biological Program – Surveys, Monitoring, and Research

The USFWS habitat management and restoration activities benefit many species of native fish, wildlife and plants on the Refuge Complex. The USFWS biological program on the Refuge Complex includes monitoring, field surveys and research studies of fish and wildlife population status, population trends and

habitat utilization. The information obtained allows the USFWS to adapt management efforts on the Refuge Complex as needed to achieve Refuge purposes and to maintain and restore natural biological diversity and ecological integrity. Data are also used in support of international, national and regional conservation initiatives.

These wildlife conservation efforts focus on achieving the following refuge goal:

- GOAL 3. A comprehensive biological program will guide and support conservation efforts for all species of native fish, wildlife and plants on the Texas Chenier Plain Refuge Complex.

1. Waterfowl, Shorebirds, and other Wetland-Dependent Migratory Birds

The biological program objective for waterfowl, shorebirds and other wetland-dependent migratory birds is to maintain healthy populations and document population trends, status and habitat utilization of waterfowl and other priority wetland-dependent migratory bird species on the Refuge Complex. The objective for Mottled Ducks is to maintain favorable habitat conditions for the year-round needs of the Mottled Duck on the Refuge Complex, including nesting, brood-rearing, molting and wintering habitats.

No Change from biological program activities in Refuge Management Alternative A.

2. Migratory and Resident Landbirds

The biological program objective for migratory and resident landbirds is to help maintain healthy populations, document population trends, status, and habitat utilization of priority species on the Refuge Complex.

No Change from biological program activities in Refuge Management Alternative A.

3. Fish and other Aquatic Species

The biological program objective for fish and other aquatic species is to help maintain healthy populations and document population trends, status and habitat utilization of priority species on the Refuge Complex. A second objective is to incorporate fisheries and aquatic resource management into the management of all estuarine marshes on the Refuge Complex.

No Change from biological program activities in Refuge Management Alternative A.

4. Threatened and Endangered Species, Species of Conservation Concern

The biological program objective for Threatened and Endangered species, Species of Conservation Concern, and other “watch species” is to support recovery efforts and to obtain information on population trends, status and habitat utilization of sensitive and/or declining species utilizing the Refuge Complex. Eight federally-listed Threatened and Endangered species occur on or adjacent to the Refuge Complex: Bald Eagle, Piping Plover, Brown Pelican, Loggerhead sea turtle, Kemp’s Ridley sea turtle, Green sea turtle, Hawksbill sea turtle, and Leatherback sea turtle.

No Change from biological program activities in Refuge Management Alternative A.

5. Mammals

The biological program objective for mammals is to maintain healthy populations and to document population trends, status and habitat utilization of priority species on the Refuge Complex.

No change from biological program activities in Refuge Management Alternative A.

6. Reptiles and Amphibians

The biological program objective for reptiles and amphibians is to maintain healthy populations and natural diversity, and to document population status and trends. The objective for alligators is to maintain alligator populations at self-sustaining levels, but at densities consistent with migratory bird management objectives.

No change from biological program activities in Refuge Management Alternative A.

7. Invertebrates

The biological program objective for invertebrates is to maintain healthy populations and natural diversity, and document species occurrence on the Refuge Complex.

No change from biological program activities in Refuge Management Alternative A.

8. Plant Resources

The biological program objective for plant resources is to maintain native plant species diversity and to document native species composition and plant community changes over time on the Refuge Complex.

No change from biological program activities in Refuge Management Alternative A.

C. Addressing Threats to the Ecosystem

Under Refuge Management Alternative C, the USFWS would increase efforts aimed at reversing trends of loss and degradation of native habitats by increasing efforts to address the effects of relative sea level rise and reduced sediment supply, altered hydrologic processes, exotic and invasive species and environmental contaminants. These efforts would include expanded coordination with other agencies and conservation organizations with a goal of implementing large-scale shoreline protection and hydrologic restoration projects. The USFWS would also implement smaller scale erosion abatement projects along the Gulf, Galveston Bay, and the GIWW and hydrologic restoration projects throughout the Refuge Complex.

These efforts addressing threats to ecosystem health focus on achieving the following Refuge goal:

- GOAL 4. By working with others locally and on a landscape level, threats to natural biological diversity, ecological integrity, and environmental health on the Texas Chenier Plain Refuge Complex will be addressed.

1. Coastal Land Loss

The objective for the threat from relative sea level rise and reduced sediment supply is to decrease rates of coastal land loss due to shoreline erosion along the Gulf of Mexico, East Galveston Bay, and the GIWW. Along the Texas Coast, wetland losses between the mid-1950's and mid-1990's were most substantial for estuarine emergent marshes (Moulton *et al.* 1997). Relative sea level rise and reduced coarse sediment supply to Gulf and bay nearshore littoral systems are resulting in significant loss of coastal habitats. Average rates of shoreline retreat along the Gulf adjacent to the refuges are as high as 50 feet per year on Texas Point NWR, and 10-15 feet per year along most of McFaddin NWR (Bureau of Economic Geology unpublished data, Morton 1998). Over 800 acres of dunes and emergent marsh has been lost due to Gulf shoreline erosion on these refuges during the last 25 years, and remaining inland marshes are increasingly threatened by more frequent inundation during high tidal events. Although less severe, erosion along the East Galveston Bay shoreline is also causing wetland loss on Anahuac NWR, and also threatens remaining marshes with saltwater intrusion. Erosion along the GIWW is also causing direct loss of wetlands and poses a significant threat to marshes from saltwater intrusion on both

McFaddin and Anahuac NWRs. Levees created when the GIWW was constructed have almost entirely eroded away along significant portions of its length within these refuges.

Current USWS efforts to address threats from relative sea level rise and reduced sediment supply would continue as in Refuge Management Alternative A. Proposed additional activities and modifications include:

- Increase coordination with the U.S. Army Corps of Engineers, National Marine Fisheries Service, Texas General Land Office, Texas Parks and Wildlife Department, Galveston Bay Estuary Program, Texas Department of Transportation and other local, state and federal agencies to develop and implement long-term inter-jurisdictional strategies to reduce coastal land loss along the Gulf of Mexico, East Galveston Bay and the GIWW. Goals would include implementing major projects to restore the Gulf barrier beach/dune complex on McFaddin NWR (dependent upon the results of ongoing sand source investigations, possibly using off-shore sand supplies), to restore sediment supply to the Gulf's nearshore littoral zone on Texas Point NWR through the beneficial use of dredge material, and to construct structural protection (rock breakwaters) and restore emergent marshes along shorelines of Galveston Bay (Anahuac NWR) and the GIWW (Anahuac and McFaddin NWRs).
- Participate in the U.S. Army Corps of Engineers new Regional Sediment Management program.
- Increase coordination among state, federal and local agencies on the issue of relative sea level rise and promote advanced conservation planning to address threats.
- Develop partnerships with universities and the U.S. Geological Survey, and facilitate and support new research and monitoring on marsh accretion and its relation to management practices including burning and structural marsh management.
- Install an additional 7,500 linear feet of shoreline erosion abatement (offshore rock wave breaks) and restore 10 acres of undershore emergent marsh (smooth cordgrass plantings) along East Galveston Bay shoreline on Anahuac NWR.
- Restore an additional 5,000 linear feet of the dunes along the Gulf of Mexico on McFaddin NWR.
- Protect an additional 10,000 linear feet of GIWW shoreline on McFaddin and Anahuac NWRs using offshore wave breaks, shoreline armoring, and/or emergent plantings (smooth cordgrass).

2. Altered Hydrologic Processes

The objective for the threat from altered hydrologic processes and resulting interior marsh loss is to protect existing and restore emergent coastal marsh habitat on the Refuge Complex by reducing saltwater intrusion, increasing freshwater and inflows and mineral sediment supply to marshes, and maintaining natural marsh hydroperiods. Land subsidence and sea level rise, channel construction, and channelization of natural waterways has had significant hydrologic impacts including saltwater intrusion, increased tidal energies causing erosion of organic marsh substrates, loss of freshwater inflows and reduced mineral sediment supply to marshes, and excessive flooding or drainage/drying of marshes. Over the last century, these factors have gradually converted extensive areas of fresh and intermediate marshes to a more brackish regime thereby decreasing natural biological diversity, and in some areas have resulted in conversion of vegetated emergent marshes to open water (marsh loss). Relative sea level rise threatens further loss of vegetated marsh due to submergence and increased saltwater intrusion. To survive, remaining marshes must accrete or gain elevation at a rate that keeps up with relative sea level rise. Maintaining plant productivity and preventing loss of organic marsh soils by restricting saltwater intrusion and tidal energies, increasing freshwater inflows, and beneficially using dredge materials to increase mineral sediment supply appear to offer the most realistic options for reversing current trends of interior marsh loss in the Chenier Plain region.

USFWS activities addressing altered hydrologic processes in Refuge Management Alternative A would continue. Proposed additional activities and modifications include:

- Expand coordination with local, state and federal agencies to develop and implement watershed-scale hydrologic restoration projects. A key component would be assessing the feasibility of and identifying options for restoring freshwater inflows to coastal marshes within the Salt Bayou watershed south of the GIWW.

- Expand coordination with the U.S. Army Corps of Engineers, Texas General Land Office, Texas Parks and Wildlife Department, Texas Department of Transportation and others to develop strategies to restore and enhance wetlands on the Refuge Complex through the beneficial use of dredged materials. This will include participation in the U.S. Army Corps of Engineers new Regional Sediment Management program.
- Throughout the Refuge Complex, replace selected water control structures with rock weirs following completion of watershed hydrologic restoration projects which reduce saltwater intrusion and increase freshwater inflows.
- Develop partnerships with universities and the U.S. Geological Survey, and facilitate and support new research and monitoring on marsh accretion and its relation to management practices including burning and structural marsh management.
- Monitor status and trends of Refuge Complex wetlands through enhanced Geographic Information System capabilities.
- Research the availability of, and if possible, acquire additional water rights to facilitate increasing freshwater inflows to the Anahuac NWR's East Unit from East Bay Bayou and Onion Bayou and to the Middleton Tract from Elm Bayou.
- Coordinate with Trinity Bay Conservation District and other partners to repair saltwater barriers and water control structures on East Bay, Elm and Onion bayous.
- On Anahuac NWR, construct a passive overflow spillway structures East Bay and Elm bayous to restore over bank flooding and freshwater inflows into East Unit marshes.
- On Anahuac NWR, construct rock weirs in constructed channels in northern portion of Pace Tract to reduce saltwater intrusion and decrease tidal energies.
- On Anahuac NWR, enhance water management by replacing water control structures and restoring levees along East Bay Bayou on the East Unit and Middleton Unit.
- On McFaddin NWR, restore hydrology by reducing saltwater intrusion and restoring marsh hydroperiods through construction of rock weirs and/or earthen plugs in constructed channels in the Willow/Barnett Lake Unit.
- Research the availability of and need for acquiring water rights to ensure that freshwater inflows remain adequate to maintain the natural diversity and productivity of the Willow Slough marsh on the McFaddin NWR North Unit.
- Restore natural hydrology to western marshes on McFaddin NWR by restoring Mud Bayou to its historic dimensions through construction of a rock weir.
- Coordinate with state and federal agencies and others to develop and implement comprehensive hydrological restoration on Texas Point NWR. Reducing saltwater intrusion and tidal energies by restoring Texas Bayou to historic dimensions and reducing the influence of constructed channels will be key components of this project.
- Throughout the Refuge Complex, restore surface hydrology by removing barriers formed by abandoned roads, levees and well pads remaining from past oil and gas development and agricultural activities.

3. Invasive Species

The objective for the threat from invasive species is to implement a comprehensive invasive species control program utilizing Integrated Pest Management strategies which will: 1) reduce current infestations by 50% within 15 years; and 2) prevent any new infestations. Monocultures of invasive plants reduce natural biological diversity, increase erosion, alter nutrient cycling and displace macro- and micro-fauna that depend on native plants for habitat and food (Sheley and Petroff 1999). Refuge habitats are currently significantly impacted by exotic plants and animals including: Chinese tallow (*Sapium sebiferum*), water hyacinth (*Eichhornia crassipes*), alligator weed (*Alternanthera ohilcoeroides*), water lettuce (*Pistia stratiotes*), McCartney rose (*Rosa bracteata*), vasey grass (*Paspalum urvillei*), Johnson grass (*Sorghum halepense*), *Cyperus enterianus*, Eurasian water milfoil (*Myriophyllum spicatum*), hydrilla (*Hydrilla verticillata*), *Salvinia minima*, Japanese honeysuckle (*Lonicera japonica*) red imported fire ants, nutria, and feral hogs. Giant salvinia (*S. molesta*), to date documented on the Refuge Complex only once and in small amounts near a refuge boat ramp, has been found nearby and poses a significant threat to freshwater wetlands. Invasive native plant species include eastern baccharis (*Baccharis halimifolia*), big-

leaf sumpweed (*Iva frutescens*), rattlebox (*Sesbania drummondii*), common reed (*Phragmites communis*) and cattail (*Typha* spp.).

USFWS efforts addressing invasive species in Refuge Management Alternative A would continue. Proposed activities through an expanded Integrated Pest Management program would include:

- Throughout the Refuge Complex, expand field monitoring to provide early detection of new infestations, and develop enhanced GIS capabilities to map existing and new stands of upland and aquatic exotic and invasive plants.
- Develop new partnerships with universities and the U.S. Geological Survey Biological Resources Division to evaluate exotic and invasive species control strategies.
- On Anahuac NWR, evaluate control strategies for deep-rooted sedge and several exotic grasses currently impacting upland prairie habitats.
- On Anahuac NWR, mechanically remove Chinese tallow along the GIWW, Oyster Bayou, East Bay Bayou, Onion Bayou, and State Highway 124.
- On Anahuac NWR, increase coordination with the Trinity Bay Conservation District and the Chambers-Liberty Counties Navigation District on control of aquatic and terrestrial invasive exotic plants on waterways, canals and ditches and on banks and levees within drainage and irrigation easements throughout the Anahuac NWR.
- Evaluate use of approved and permitted biological control agents as they become available, for use in IPM program for exotic and invasive species control. An approved biological control agent for *Salvinia* spp. is now available for release in Texas, and its use on the Refuge Complex will be evaluated.
- Expand integrated control activities for water hyacinth in the Willow Slough Marsh on the North Unit of McFaddin NWR.
- On Texas Point NWR, utilize spot herbicide treatments to help control McCartney rose on non-saline prairie habitats.
- On the Refuge Complex, expand control efforts for invasive emergent marsh plants such as cattail and common rush where encroachment has resulted in loss of desirable open water habitats.
- Develop exotic aquatic plant interpretive signs and install them at all Refuge Complex boat ramps.
- Develop step-down Feral Hog Management and Nuisance Animal Management plans. Expand control efforts for feral hogs and nutria as necessary.

4. Contaminants

The objective for the threat from contaminants is to, within 15 years, identify and monitor all potential point and non-point source pollution impacts to the Refuge Complex and develop a strategy to clean up contaminants and protect refuge resources from those impacts. Contaminant issues affecting the Refuge Complex include potential petroleum and petrochemical spills from: 1) on-Refuge oilfield operations; 2) shipping on the GIWW; and 3) offshore production in the Gulf. The potential for petrochemical and petroleum spills affecting the Refuge Complex is high. Over 20 active oil and gas wells are currently producing on the Refuge Complex. Significant drilling and production activity occurs in Gulf waters offshore of McFaddin and Texas Point NWRs. The GIWW between Houston and Lake Charles, Louisiana is one of the busiest reaches of this waterway for shipping petrochemical and petroleum products. The GIWW parallels much of McFaddin and Anahuac NWRs, and the Sabine-Neches Ship Channel parallels Texas Point NWR. Former and current oil and gas production areas on the Refuge Complex contain extensive infrastructure which is no longer in use, including flow lines, pipelines, oil pits, well pads, and brine disposal areas. Many of these lines, pits, and pads may contain contaminants including heavy metals, normal occurring radio-active material, brine, and petroleum products. In addition, Refuge Complex marshes comprise the downstream end of at least 10 waterways. Factories, refineries, solid waste disposal sites, oil field sludge disposal areas, feedlot operations, agricultural operations and housing developments are potential pollution sources in upstream reaches of these watersheds. Finally, high levels of lead shotgun pellets likely occur over much of the Refuge Complex. Incidence of lead shot in Mottled Duck gizzards remains relatively high to the present in birds harvested

on the Anahuac and McFaddin NWRs, even after over 15 years of implementation of non-toxic ammunition regulations.

Current USFWS activities addressing threats from contaminants in Refuge Management Alternative A would continue. Proposed additional activities would include:

- Develop a comprehensive spill response plan for incidents occurring off-refuge which threaten Refuge Complex resources.
- Increase coordination with the interagency spill response programs. Integrate Refuge Complex spill response activities with interagency programs.
- Assemble and maintain a qualified first responder team comprised of Refuge Complex staff through training and participation in interagency spill response drills.
- Throughout the Refuge Complex, conduct contaminant investigations in current and former oil and gas production areas and develop clean up plans for any contaminated areas which pose threats to habitats and fish and wildlife resources.
- Conduct a thorough inventory and assessment of abandoned oil and gas infrastructure on the Refuge Complex, and develop plans for removal of abandoned facilities and habitat restoration.
- Facilitate and support water quality monitoring in Taylors Bayou, Willow Slough, Spindletop Bayou, Mud Bayou, Oyster Bayou, Robinson Bayou, East Bay Bayou, Onion Bayou, Elm Bayou and the GIWW.
- Facilitate and support field assessment to identify any potential “hot spots” of lead contamination on the Refuge Complex. Develop and implement management actions for remediating any areas with high levels of lead.

5. New Oil and Gas Exploration and Development

Minerals underlying the refuges are privately held and the USFWS must allow reasonable use of the surface of refuges to explore for and develop oil and gas reserves. The objective for managing new oil and gas exploration and development is to ensure that new oil and gas exploration and development on the Refuge Complex is conducted in the most environmentally-sensitive manner possible by defining a process which facilitates close coordination with industry and timely processing of requests to conduct activities, and which mandates the use of scientifically-accepted “best management practices” for these activities in sensitive coastal environments.

Current USFWS activities addressing management of new oil and gas exploration and development in Refuge Management Alternative A would continue. Proposed additional activities include:

- Develop a step-down Oil and Gas Management Plan for the Refuge Complex.
- Establish an Oil and Gas Management Specialist position.

D. USFWS Public Use Program

The Texas Chenier Plain Refuge Complex offers a wide variety of recreational opportunities and received over 172,000 visitors during Fiscal Year 2002. Through the use of existing programs and facilities, the Refuge Complex provides opportunities for all six of the Refuge System’s priority wildlife-dependent recreational uses, which are:

- Hunting
- Fishing
- Wildlife Observation and Photography
- Environmental Education and Interpretation

These visitor and recreational opportunities focus on achieving the following refuge goal:

- GOAL 5. All local, national and international visitors will enjoy safe and high quality outdoor experiences on the Refuge Complex, and learn of the Refuge Complex’ role in conserving the region’s coastal natural resources. New partnerships with our local communities will be forged to highlight, promote and conserve the unique natural assets of the upper Texas Gulf Coast.

1. Hunting

The objective for hunting is to provide safe and high quality waterfowl hunting opportunities on the Refuge Complex. Waterfowl hunting is a traditional and still very popular outdoor recreational pursuit in the region. Refuges and other public lands along the Gulf Coast play a key role in providing hunting opportunity to the public at large.

Current USFWS public use program activities in support of hunting would continue with no change from Refuge Management Alternative A.

2. Fishing

The objective for fishing is to provide safe and high quality fishing opportunities on the Refuge Complex. The Refuge Complex offers exceptional recreational fishing and crabbing opportunities in both saltwater and freshwater environments. Catfish, bass and brim in freshwater environments and speckled trout, flounder and red drum in saltwater environments are among the popular game fish species on the refuges. Crabbing for blue crabs is also a popular recreational pursuit along refuge waterway and lake shorelines.

Current USFWS public use program activities in support of fishing would continue with no change from Refuge Management Alternative A.

3. Wildlife Observation and Photography

The objective for wildlife observation and photography is to provide safe and high quality opportunities for wildlife observation and photography on the Refuge Complex; and, within 15 years, Refuge Complex visitors will be provided with several new, high-quality opportunities to view and photograph wildlife in restored native habitats. Because overall management of the Refuge Complex under this Alternative will emphasize native habitat restoration, new wildlife viewing and photographic opportunities would be developed for these habitats and the species they support.

Current USFWS public use program activities in support of wildlife observation and photography in Refuge Management Alternative A would continue, with the following additional facility development:

- On Anahuac NWR, develop a trail/wildlife viewing area in restored prairie habitat on the Granberry Tract unit.
- Develop a connecting trail, boardwalk and observation platform on Texas Point NWR, through woodlot, prairie and marsh habitats.
- Develop a canoe trail for wildlife observation in Star Lake/Five Mile Cut on McFaddin NWR.

4. Environmental Education and Interpretation

The objective for environmental education and interpretation is to, within 15 years, have 90% of visitors feel that they have increased their knowledge of the region's native habitats, native fish and wildlife, native habitat restoration methods, and the major threats to ecosystem health. Because overall management of the Refuge Complex under this Alternative will emphasize native habitat restoration and addressing threats to the ecosystem, educational and interpretive programs and materials should focus on restoring native habitats, native fish and wildlife and some of the major threats. Educating visitors about these resources and issues and about the Refuge Complex' conservation role in restoring and maintaining native biological diversity will lead to support and responsible stewardship.

Current USFWS public use program activities in support of environmental education and interpretation in Refuge Management Alternative A would continue; with the development of the following additional facilities and programs:

- On Anahuac NWR, develop four seasonally changing displays for the Visitor Information Station, focusing on native habitats and native biological diversity of the Refuge.
- On Anahuac NWR, develop invasive species monitoring program with local high school.

- On Anahuac NWR, develop two educational activities (one high school, one middle school level) describing neotropical migratory bird migration and the importance of protecting breeding, wintering and stopover habitat, for use in school classrooms, and followed by a field trip to the Refuge during spring migration.
- On Anahuac NWR, develop interpretive exhibits on wetland, prairie and woodlot restoration. Conduct monthly interpretive programs, for adults and youth, focusing on native habitat restoration and native biological diversity.
- On Anahuac NWR, develop an environmental education activity/program focused on native habitats, restoration methodologies, and threats to the ecosystem's natural biological diversity for older students and presentations to the general public.
- On Anahuac NWR, establish a program to work with local elementary schools to propagate native plant species for use in restoration efforts. Follow up with a designated 'planting' day and educational tour of the Refuge.
- Develop interpretive facilities on Texas Point NWR to interpret woodlot, prairie, and wetland habitats and associated fish and wildlife.
- Conduct monthly beach walks on McFaddin NWR, focusing on human impacts to natural systems.
- On Anahuac NWR, conduct teacher training workshop annually to facilitate school field trips led by school teachers, focusing on native habitats, the species those habitats support, and the role of the refuges in conserving those resources.
- Produce standardized presentation emphasizing the importance of the Refuge Complex in protecting and restoring native wetland and upland habitats.
- Develop brochures for butterflies, dragonflies/damselflies, wildflowers, reptiles and amphibians, mammals and invasive/exotic species found on the Refuge Complex.
- Develop videos interpreting Refuge Complex fish, wildlife, plants, cultural resources and restoration practices.
- Revise general brochures and websites to emphasize the Refuge Complex' role in restoring native upland and wetland habitats.

5. Beach Uses on McFaddin NWR

The objective for beach uses on McFaddin NWR is to protect public safety and natural resources along the Gulf of Mexico shoreline within the refuge.

No Change from current USFWS activities to protect public safety and natural resources on McFaddin NWR in Refuge Management Alternative A.

E. Community Outreach and Partnerships

The objective for community outreach and partnerships is to promote conservation of natural resources by working effectively with partners in support of USFWS management programs on the Refuge Complex including habitat management and restoration, fish and wildlife population management, and providing public recreational and educational opportunities. Partnerships with the Friends of Anahuac Refuge and the McFaddin and Texas Point Refuges Alliance, two citizen support groups, with state agencies such as the Texas Parks and Wildlife Department, the Texas General Land Office and the Galveston Bay Estuary Program, and with conservation organizations such as the Galveston Bay Foundation and local Audubon Society chapters have been particularly effective. Volunteers on the Refuge Complex provide over 10,000 hours of service annually. In addition, the USFWS is working with private landowners to enhance or restore coastal marsh and prairie wetlands habitat on private lands, by providing technical assistance and helping to coordinate use of several private lands programs (such as the USFWS Partners for Fish and Wildlife Program and the multi-partner Texas Prairie Wetland Project). Many private lands in the region are successfully managed to provide habitat for wintering waterfowl and other migratory birds. The objective for Private Lands Partnerships is to, within 15 years, restore or enhance 500 acres of native prairie and 10 acres of woodland habitat on private lands in the Texas Chenier Plain region through coordination with interested private landowners and the use of USFWS private lands programs.

Current USFWS community outreach and partnership activities in Refuge Management Alternative A would continue, with the following efforts to expand partnerships with private landowners to enhance upland habitats:

- On Anahuac NWR, hold two on-refuge workshops for private landowners and other agency personnel to demonstrate prairie restoration and management techniques, and to highlight available USFWS private lands programs and grant opportunities.
- Provide technical assistance to private landowners in Chambers, Jefferson and Galveston counties wishing to enhance grassland and woodland habitats for wildlife.

F. Administration and Staffing

In addition to the already existing staff positions under Refuge Management Alternative A, three essential staffing positions would be filled to implement Refuge Management Alternative C:

- Geographic Information Systems specialist
- Natural resource specialist - oil & gas management
- Plant ecologist

IV. REFUGE MANAGEMENT ALTERNATIVE D (PREFERRED ALTERNATIVE) - EMPHASIS ON AN INTEGRATED MANAGEMENT APPROACH COMBINING: 1) EXPANDED HABITAT MANAGEMENT AND RESTORATION PROGRAMS, 2) NEW RESEARCH AND WILDLIFE POPULATION MONITORING, & 3) INCREASED EFFORTS TO ADDRESS MAJOR THREATS TO THE ECOSYSTEM

Alternative D Concept

Management Focus

Under this Alternative, the Refuge Complex would continue and expand current habitat management and native habitat restoration programs, with increased monitoring and research to assess management actions and facilitate a more effective adaptive management approach. Wetland habitat management activities for waterfowl, shorebirds and other wetland-dependent migratory birds including structural water management in marshes, prescribed burning, controlled grazing, and moist soil management would be refined and enhanced, and in some cases expanded through development of new infrastructure. Concurrently, additional restoration of native habitats including wetlands, prairie and woodlots would be undertaken to benefit a variety of native fauna with a focus on priority species identified as in need of conservation through national and international conservation initiatives.

Efforts to address coastal habitat loss and degradation resulting from shoreline erosion along the Gulf, Galveston Bay and the GIWW and to restore emergent marshes would be intensified by increasing coordination among agencies and other stakeholders. Goals would include implementing large-scale partnership projects including barrier beach/dune restoration on McFaddin NWR, marsh and shoreline restoration on Texas Point NWR through the beneficial use of dredge material, and structural shoreline protection along the GIWW and East Galveston Bay. Ongoing interior marsh loss would be addressed by working with agencies and other stakeholders on watershed-scale hydrologic restoration projects that restore freshwater inflows and further restrict saltwater intrusion and increased beneficial use of dredge material to restore mineral sediment supply to marshes. The USFWS would also implement several smaller hydrologic restoration and shoreline protection projects on the Refuge Complex. Control and monitoring programs for exotic and invasive species would be intensified, and additional efforts to monitor and reduce impacts of contaminants implemented.

Through new partnerships with universities and other agencies, additional research and monitoring would be conducted to better assess impacts of relative sea level rise and to support future conservation planning to address these impacts. Additional monitoring of invasive plant species, including research to assess the efficacy of ongoing and new control techniques, would be conducted. Additional research on effects of environmental contaminants on fish and wildlife would be conducted. Additional baseline data on fish and wildlife populations and habitat use would also be collected, with an emphasis on documenting the status of several sensitive or declining species.

USFWS habitat management and restoration and biological program activities on the Refuge Complex under this Alternative will support conservation objectives and informational needs for priority species identified in regional, national and international avian conservation plans. These include plans for waterfowl and avian conservation under the North American Waterfowl Management Plan (the Gulf Coast Joint Venture's Chenier Plain Initiative Plan, Mottled Duck Conservation Plan and all-bird conservation initiative), the U.S. Shorebird Conservation Plan and step-down Lower Mississippi/Western Gulf Coast Regional Shorebird Plan, the North American Waterbird Conservation Plan, and the Partners in Flight Regional Conservation Plan for the Gulf Coast Prairies Bird Conservation Region (BCR 37) (currently in preparation).

The Refuge Complex would also continue to provide and promote opportunities for all six of the National Wildlife Refuge System's priority wildlife-dependent recreational uses: hunting, fishing, wildlife observation and photography, and environmental education and interpretation. The Refuge Complex would seek to provide additional recreational opportunities and improve the quality of visitor services and of the visitor experience through construction of additional public use facilities including a Refuge Complex Administrative Headquarters and Wildlife Interpretive Center in Chambers County, expanding law enforcement efforts to protect public safety and natural resources, providing additional hunting and fishing opportunities, and developing additional educational programs. Expanded outreach to local communities and private landowners would be aimed at developing new partnerships to further conservation and promote awareness of the region's natural resources.

Rationale for this Management Focus

The coastal marshes, prairies and woodlots of the Chenier Plain region of southwestern Louisiana and southeast Texas comprise a hemispherically important biological area. The Texas Gulf Coast is the primary site for ducks wintering in the Central Flyway, with an average of 1.3-4.5 million birds, or 30-71% of the total flyway population (Stutzenbaker and Weller 1989). This area also winters 90% of the snow, Canada, and greater white-fronted geese in the Central Flyway (Buller 1964). Additionally, the coastal marshes, prairies and prairie wetlands of the Chenier Plain region of the Texas Gulf Coast serve as a critical staging area for Central Flyway waterfowl migrating to and from Mexico and Central and South America. Hundreds of thousands shorebirds, wading birds, and other marsh and waterbirds also winter or migrate through the region, including several now identified by the USFWS as Avian Species of Conservation Concern. Coastal prairie and coastal woodlots support over 150 migratory and resident land bird species, including 9 species of grassland birds and 7 species utilizing woodland habitats listed as Rare and Declining within the Coastal Prairies Region of Texas (Texas Parks and Wildlife Department 2000). Overall, wetland, prairie and woodland habitats on the Refuge Complex provide habitat for 33 Avian Species of Conservation Concern in the Gulf Prairies Bird Conservation Region.

The high degree of alteration in this ecosystem has resulted in loss and degradation of native habitats, loss of biological diversity, and decreased habitat quality for migratory birds and other native wildlife. Alterations of historic hydrology including loss of freshwater inflows and increased saltwater intrusion, coastal erosion, land subsidence and sea level rise are contributing to ongoing coastal land loss and marsh degradation. Almost all of the region's historic native tallgrass coastal prairie and its associated prairie wetlands have disappeared, and remaining coastal woodlots are imminently threatened by development and other land use changes. Several highly invasive exotic plant species are replacing native habitats and severely impacting native biological diversity. Air and water quality issues in the region pose a potential contaminant threat to fish and wildlife, as do accidental spills and discharges from the major petrochemical shipping, storage and processing facilities located in close proximity to sensitive Refuge Complex habitats. Habitat losses to date and ongoing threats in this ecosystem are such that intensive management of remaining habitats in combination with habitat restoration where feasible is required to conserve fish and wildlife resources.

The Refuge Complex provides over 170,000 annual visitors opportunities to waterfowl hunt, fish for fresh and saltwater species, observe and photograph wildlife, and learn about this coastal ecosystem through interpretive and environmental education programs. Southeast Texas has a long and rich tradition of outdoor recreation. Demand for these recreational opportunities on public lands and waters are increasing. The human population in the 8-county area surrounding Houston now exceeds 6 million people. The Texas Gulf Coast has become a popular destination for national and international nature tourists. Improving visitor services and the quality of the visitor experience on these refuges is a critical component of future management.

A. USFWS Habitat Management and Restoration

The primary focus of USFWS land management activities on the Refuge Complex is to fulfill the establishment purpose(s) for the Refuges, i.e., for the conservation and management of migratory birds and their habitats. Under Refuge Management Alternative D, the USFWS would continue and expand

current habitat management and native habitat restoration programs, with increased monitoring and research to assess management actions and facilitate a more effective adaptive management approach. Wetland habitat management activities for waterfowl, shorebirds and other wetland-dependent migratory birds including structural water management in marshes, prescribed burning, controlled grazing, and moist soil management would be refined and enhanced, and in some cases expanded through development of new infrastructure. Concurrently, additional restoration of native habitats including wetlands, prairie and woodlots would be undertaken to benefit a variety of native fauna, with a focus on benefiting priority avian species.

These habitat management activities focus on achieving the two following Refuge goals:

- GOAL 1. Conserve, enhance and restore the Texas Chenier Plain region's coastal wetlands to provide wintering, migrational, and nesting/brood-rearing habitat for waterfowl, shorebirds, marsh and wading birds, other wetland-dependent birds, and habitat for other native fish and wildlife.
- GOAL 2. Conserve, enhance and restore the Texas Chenier Plain region's coastal prairies and coastal woodlands to provide wintering, migrational, and nesting habitat for resident and migratory landbirds, including neotropical/nearctic migratory birds, and habitat for other native wildlife species.

1. Wetland Specific Management and Restoration

Managed marsh units within the Refuge Complex are under varying degrees of structural control, and may be best described as marsh semi-impoundments. Some units are entirely or almost entirely behind man-made levees and water control structures, and are intensively managed through manipulation of the water control structures. Most are managed less intensively, relying to some degree on natural topography and drainage to control hydrologic regimes.

a. Emergent Wetlands

The objective for emergent wetlands (estuarine and palustrine) is to maintain the historic continuum of fresh, intermediate, brackish and saline coastal marshes on the Refuge Complex and its diverse mosaic of plant communities, and on an annual basis, to manage and maintain 30 to 40% of fresh and intermediate emergent coastal marshes on the Refuge Complex in target plant communities which contain several early and mid-successional emergent plant species. Meeting the habitat needs of the region's diversity of wetland dependent resident and migratory birds requires maintaining a range of coastal marsh habitat types and plant community successional stages within these marsh types. Providing freshwater inflows and restricting saltwater intrusion are critical to maintaining the Chenier Plain's historic continuum of fresh, intermediate, brackish saline marshes. Habitat values for waterfowl, shorebirds and many wading bird species are greatly enhanced in intermediate marshes with early successional plant communities containing several perennial and annual plant species (primarily grasses and sedges) which provide important food resources, and where disturbance reduces the height and/or density of vegetation. Perennial emergent plants important to wintering waterfowl include seashore paspalum (*Paspalum vaginatum*) and Olney bulrush (*Scirpus olneyi*). Early successional emergent plant species important to waterfowl include annual grasses such as millet (*Echinochloa* spp.) and sprangle-top (*Leptichloa fascicularis*) and forbs such as water hyssop (*Bacopa monnieri*) and purple ammania (*Ammania coccinea*). Migratory bird species such as rails require denser vegetation and plant species composition typical of later successional stages (Fredrickson and Taylor 1982). Coastal marshes have evolved with disturbance regime which includes fire, herbivory by native wildlife, and infusion of saline waters during tidal surges associated with tropical storms. Natural fire and herbivory by native species now occur less frequently or at reduced levels due to human influences on the ecosystem (Stutzenbaker and Weller 1989). Water level and salinity management, prescribed burning, and controlled grazing are available tools for influencing plant communities (species composition and physical structure) in marsh habitats.

USFWS management activities for emergent wetlands in Refuge Management Alternative A would continue; with the following modifications and additional activities:

- On Anahuac NWR, ensure adequate freshwater in-flows and reduce saltwater intrusion through annual water purchases and enhanced water management infrastructure including new pumps and delivery systems.
- Maintain current rotational prescribed burning program in marsh units on the Refuge Complex, conducted from late September to late-November (to the extent permitted by environmental/climatic conditions and air quality parameters) to maximize the benefits of integrated burning/grazing/water management programs. Initiate limited summer prescribed burning to control invasive woody vegetation including *Baccharis* (*Baccharis halimifolia*) and big-leaf sumpweed (*Iva frutescens*) in portions of targeted marsh management units.
- Modify controlled grazing program on the Refuge Complex increasing grazing intensity (given favorable forage and water conditions) in several intermediate and fresh marsh units.
- Reconfigure grazing units on the Refuge Complex through additional fencing and development of additional watering sites to increase the effectiveness and efficiency of the control grazing program.
- Increase herbivory by native wildlife on McFaddin NWR by developing new grit sites and maintaining sanctuary areas for geese through the special white goose conservation season (in effect since 1999) which follows the regular waterfowl season.
- Initiate and conduct short and long-term ecological fire effects monitoring on the Refuge Complex and use results to guide an adaptive approach to implementing the prescribed burning program.
- Facilitate and support ongoing and new research studies to determine fire effects on marsh accretion, soils, vegetation, and wildlife.
- Develop a step-down Nuisance Animal Management Plan to protect emergent marshes from excessive herbivory by nutria (an exotic species) and by high populations of muskrats.

b. Open Water Wetlands (Estuarine and Palustrine)

The objective for open water wetlands (estuarine and palustrine) is to increase species diversity and production of submerged aquatic vegetation in marsh habitats and increase open water habitat by 10% in the fresh and intermediate marshes within the Refuge Complex. The submerged aquatic plant community serves as a direct source of important waterfowl foods (e.g., seeds and tubers), and indirectly, as a rich environment for aquatic macroinvertebrates, which are heavily utilized by waterfowl and many other wetland birds (Baldassarre and Bolen 1994). These habitats are extremely important for brood-rearing and molting Mottled Ducks (Stutzenbaker 1988); and, these habitats are important to fishery resources providing vital nursery habitat for many species of marine fish and shellfish (Stutzenbaker and Weller 1989). The diversity and productivity of aquatic plant communities are also dependent upon maintenance of the historic continuum of fresh to saline marsh types. Water level and salinity management within marsh semi-impoundments are important tools for restoring and maintaining submerged aquatic vegetation production and species diversity. Construction of artificial barriers in larger open water wetlands to reduce wave fetch and turbidity can promote the establishment and growth of submerged aquatic vegetation. Common reed (*Phragmites communis*), cattail (*Typha* spp.) and California bulrush (*Scirpus californicus*) are aggressive plant invaders which can form dense homogeneous stands in open water habitats in brackish to fresh marshes. In fresh marsh environments, establishment and expansion of maiden cane (*Panicum hemitomen*) and giant cutgrass (*Zizaniopsis miliacea*) can also result in loss of open water habitats. Submerged aquatic vegetation production is substantially reduced due to shading and loss of substrate when extensive encroachment by these species occurs.

USFWS management activities for open water wetlands in Refuge Management Alternative A would continue, with the following modifications and additional activities:

- On Anahuac NWR, improve water level management capabilities in Shoveler Pond, Rail Reservoir, Moccasin Pond, Otter Pond, and East Unit South Reservoir of Anahuac NWR by modifying existing and installing new water control structures.
- On McFaddin NWR, enhance water level and salinity management in Wild Cow Bayou Management Unit by installing additional water control structures along the GIWW and

rehabilitating levees (LeBlanc's Reservoir, Pond 11, Pond 13), and modifying the existing western levee system to prevent saltwater intrusion.

- On McFaddin NWR, enhance water management in Willow and Barnett Lake units of McFaddin NWR through design and construction of new water control structures along the GIWW.
- On McFaddin NWR, enhance water management in Willow Slough (North Unit of McFaddin NWR) through design and construction of new water control structures/spillways and associated management infrastructure.
- On McFaddin NWR, construct marsh terraces to reduce fetch and turbidity and increase production of submerged aquatic vegetation in Willow/Barnett Lake area and Ponds 28 and 29 on McFaddin NWR, and as needed in open water areas on Texas Point NWR and Anahuac NWR.
- Throughout the Refuge Complex, implement an integrated control program for common reed, cattail and other emergent plants resulting in loss of open water habitats using herbicide application, mechanical removal, salinity control, prescribed burning and controlled grazing on selected units including the Deep Marsh, East Unit and Middleton Tract units of Anahuac NWR, and the White's Fee, Wild Cow Bayou, White's Pasture and North Unit of McFaddin NWR. Expand control efforts over the life of the CCP using the most effective strategies.
- Develop enhanced Geographic Information System capabilities to monitor status and trends of Refuge Complex wetlands. Use GIS technology, remote sensing, LIDAR surveys and other tools to map micro-topography and define watersheds, quantify water usage, and detect trends in open water to emergent marsh ratios and large-scale vegetative changes.
- Facilitate and support a research study to identify causative factors of the "black water phenomenon" which negatively impacts submerged aquatic vegetation production in marsh habitats, and to guide development of adaptive management strategies to prevent or minimize these impacts.

c. Freshwater Prairie Wetlands (Palustrine)

The objective for freshwater prairie wetlands (palustrine) is to, within 15 years, maintain approximately 1,900 acres of managed and natural shallow freshwater wetlands on the Refuge Complex; and, actively manage adjacent prairie habitat for Mottled Ducks and other ground nesting migratory birds. The loss of native prairie habitats and their associated shallow prairie wetlands have been substantial along the Texas Coast (Moulton *et al.* 1997). A large portion of the upper Texas Coast prairie habitats have been cultivated for rice production, which provides valuable habitat for waterfowl, shorebirds, and many other migratory birds (Hobaugh *et al.* 1989, Wilson 2001). However, rice production has declined significantly during the last decade in counties surrounding the Refuge Complex, reducing available prairie wetland habitat for waterfowl, shorebirds and other wetland-dependent species. Mottled ducks heavily utilize prairie habitats adjacent to freshwater wetlands for nesting (Stutzenbaker 1988).

USFWS management activities for freshwater prairie wetlands in Refuge Management Alternative A would continue; with the following modifications and additional activities:

- On Anahuac NWR, maintain annual rice farming acreage at 500-700 acres per year, while increasing acreage which is organically farmed.
- On Anahuac NWR, increase moist soil management acreage to 1,100 acres annually by developing 590 acres of new moist soil management units on the Old Anahuac, East Unit, and Middleton Tract units.
- On Anahuac NWR, restore 100 acres of shallow depressional prairie wetlands on the Granberry Tract Unit and the East Unit.
- Restore 100 acres of shallow freshwater wetland habitat on McFaddin NWR by developing moist soil management units.
- Create shallow freshwater wetland habitat in dredge material disposal sites along the GIWW on McFaddin NWR by installing levees and water control structures during future maintenance dredging cycles. This will involve development of cooperative projects with the U.S. Army Corps of Engineers. .

2. Upland Specific Management and Restoration

a. Native Prairie and other Grasslands

The objective for native prairie and other grasslands is to protect and manage all of the 5,744 acres of non-saline grassland habitats on the Refuge Complex, including “prairie remnants”, permanently fallowed former croplands which are naturally revegetating, and sites previously restored to native prairie using intensive restoration techniques. Prescribed burning, controlled grazing, mowing (and haying) and exotic/invasive plant control would be the primary management tools employed. A second objective is to within 15 years, restore an additional 2,223 acres of fallowed former cropland to native prairie on Anahuac NWR using intensive restoration techniques.

It is now estimated that 99.8% and 99.6% of little bluestem and eastern gamma grass/switch grass prairies, respectively, have been lost in Texas (McFarland 1995). Nine of the 13 avian species listed as Rare and Declining within the Coastal Prairies Region in Texas (Texas Parks and Wildlife Department 2000) are present in grasslands on the Refuge Complex. In 2005, the USFWS listed 7 avian species occurring in prairie habitats on the Refuge Complex as Avian Species of Conservation Concern in the Gulf Prairies Bird Conservation Region. Restoration of native prairie and an integrated management approach utilizing prescribed fire, exotic plant control and controlled grazing is needed on the Refuge Complex to provide large blocks of nesting and wintering habitat for prairie-dependent avian and other wildlife species.

USFWS management activities for native prairie and other grassland habitats in Refuge Management Alternative A would continue; with the following modifications and additional activities:

- On Anahuac NWR, restore an additional 2,223 acres of native prairie using intensive restoration techniques on the following management units: Gator Marsh – 97 acres, North Gator Marsh – 204 acres, Longtom Prairie – 186 acres, Pintail Marsh – 120 acres, Airstrip Prairie and East Bay Bayou Marsh – 1,000 acres, Middleton – 370 acres.
- On Anahuac NWR, construct a 5-acre native prairie grass propagation area on the East Unit to increase native grass seeds for use in the prairie restoration program.
- Modify the controlled grazing program on the Refuge Complex on upland units to include more short-duration/high-stocking rate grazing episodes.
- On the Refuge Complex, continue to conduct prescribed burns in prairie units in the spring, and initiate limited summer burning to help control invasive and exotic woody vegetation.

b. Coastal Woodlands

The objective for coastal woodlands is to, within 15 years, create 29 acres of new coastal woodlots on the Refuge Complex, and protect and diversify the 127 acres of existing woodlots and riparian woodlands. Coastal woodlots in the Chenier Plain region are extremely important to migrating songbirds (Rappole 1974, Sprunt 1975, Mueller 1981). Refuge Complex woodlands mark the first landfall for hundreds of thousands neotropical migratory birds making the trans-Gulf flights from Mexico, Central and South America during the spring migration. These birds spend one to several days in woodlands resting and foraging to help replenish fat reserves before continuing their migration to breeding habitats. During the fall migration, coastal woodlots provide the last opportunity for trans-Gulf migrants to increase their fat levels necessary for crossing the Gulf of Mexico (Caldwell *et al.* 1963). Migrant landbirds made greater use of woodlots with larger trees and denser under stories (Mueller and Sears 1987). Increasing the quality of habitat in Refuge Complex woodlots for migratory landbirds requires removing exotic plants and increasing under story density and species diversity.

Current USFWS management activities to achieve objectives for coastal woodlands would continue as in Refuge Management Alternative A. Proposed additional activities include:

- On Anahuac NWR, create two 1-acre woodlots, one near the VIS and one at the Volunteer housing area. Create a 27-acre woodlot on the East Unit along East Bay Bayou.

- Conduct site suitability assessment of additional areas on the Refuge Complex and work with partners to create additional woodlot habitats on suitable sites.
- Expand feral hog control efforts.

B. USFWS Biological Program – Surveys, Monitoring, and Research

The USFWS habitat management and restoration activities benefit many species of native fish, wildlife and plants on the Refuge Complex. The USFWS biological program on the Refuge Complex includes monitoring, field surveys and research studies of fish and wildlife population status, population trends and habitat utilization. The information obtained allows the USFWS to adapt management efforts on the Refuge Complex as needed to achieve Refuge purposes and to maintain and restore natural biological diversity, biological integrity and environmental health. Data collection will be integrated with and support regional, national and international conservation initiatives for priority species whenever possible.

These wildlife conservation efforts focus on achieving the following Refuge goal:

- GOAL 3. A comprehensive biological program will guide and support conservation efforts for all species of native fish, wildlife and plants on the Texas Chenier Plain Refuge Complex.

1. Waterfowl, Shorebirds, and other Wetland-Dependent Migratory Birds

The objective for waterfowl, shorebirds and other wetland-dependent migratory birds is to help maintain healthy populations of species utilizing the Refuge Complex and to document population status and trends and habitat utilization of priority species. Coastal habitats of the Texas Chenier Plain region provide important wintering and migrating habitat for waterfowl of the Central Flyway, and for millions of shorebirds, wading birds, colonial nesting waterbirds, and other wetland-dependent migratory birds. Monitoring and studies of population trends and habitat utilization provide information to assess management activities on the Refuge Complex. Data are also used in support of international, national and regional migratory bird conservation initiatives.

USFWS biological program and management activities for waterfowl, shorebirds and other wetland-dependent migratory birds under Refuge Management Alternative A would continue. Proposed additional activities supporting conservation of wetland-dependent migratory birds on the Refuge Complex include:

- Conduct new surveys and studies for sensitive/declining species (see objective for Threatened and Endangered Species).
- On Anahuac NWR, provide migrational habitat for shorebirds annually during March/April/May on 300 acres of the refuge's moist soil units.
- Develop step-down Inventory and Monitoring Plan to guide the Refuge Complex biological program.

The objective for Mottled Ducks, an important resident waterfowl species, is to increase breeding pair densities in suitable habitats on the Refuge Complex to at least 11 breeding pairs per square mile (the 15-year average for the period 1988-2002); and, gather additional information on the factors impacting Mottled Duck populations in the Texas Chenier Plain region through applied research and monitoring. Both spring breeding pair and September aerial surveys conducted by the USFWS indicate a steady decline in Mottled Duck populations on coastal national wildlife refuges in Texas over the last 16 years. While drought conditions along much of the Texas Coast during late 1990's undoubtedly contributed to this decline, other potential causative factors include loss of freshwater wetlands and upland nesting habitat due to land use changes, loss of pair bond, brood rearing and molting habitats due to invasive plant encroachment in open water habitats, brush encroachment in nesting habitats, increased predation by alligators, mammalian predators and fire ants, and lead shot ingestion rates that have remained high in some areas.

USFWS biological program and management activities for Mottled Ducks described in Refuge Management Alternative A would continue. Proposed additional USFWS biological program and management activities supporting conservation of Mottled Ducks on the Refuge Complex include:

- Expand and refine annual Mottled Duck breeding pair index survey on the Refuge Complex to include an assessment of Mottled Duck use by habitat type (fresh, intermediate, and brackish marshes).
- Facilitate and support new research including studies to: 1) evaluate Mottled Duck nesting success and brood survival and identify factors affecting these vital rates; 2) determine habitat utilization and preferences during nesting, brood rearing, and molting periods; and 3) evaluate effects of predation by alligators, mammalian predators and fire ants on Mottled Duck survival. This would include removing alligators and mammalian predators from key Mottled Duck nesting and brood-rearing habitats, and assessing impacts on nest success and duckling survival.
- Manage 400 acres of moist soil units annually on Anahuac NWR specifically to provide brood-rearing habitat for Mottled Ducks during summer.
- Enhance management capabilities for Mottled Ducks on 300 acres of freshwater impoundments within the Wild Cow Bayou Management Unit on McFaddin NWR by rehabilitating existing levees and installing new water control structures. Intensively manage approximately 400 hundred acres of marsh habitat located adjacent to freshwater impoundments as optimum brood-rearing habitat.
- Develop and maintain at least two grit sites for Mottled Ducks within the Wild Cow Bayou Management Unit of McFaddin NWR.
- Restore pair pond and brood rearing habitats in key management units on the Refuge Complex (those currently supporting breeding Mottled Ducks) by restoring open water habitats lost to invasive plant encroachment, using an integrated approach (an intensified program involving prescribed burning, controlled grazing, water level and salinity management, mechanical removal, and spot herbicide treatments).
- Provide additional open, shallow freshwater habitat in and adjacent to key management units (those currently supporting breeding Mottled Ducks).
- Maintain optimal nesting cover in salty prairie habitats by applying prescribed fire and grazing at designated frequencies and intensities, based on ongoing site-specific assessments. Manage fire occurrence in salty prairie and other optimum nesting cover using mowed green fire breaks and other innovative techniques.

2. Migratory and Resident Landbirds

The biological program objective for migratory and resident landbirds is to help maintain healthy populations of species utilizing the Refuge Complex, and to document population trends, status and habitat utilization of priority species. Monitoring and study of population trends and habitat utilization provides information used to assess and improve management activities on the Refuge Complex. Data are also used in support of international, national and regional migratory bird conservation initiatives.

USFWS biological program and management activities for migratory and resident landbirds under Refuge Management Alternative A would continue. Proposed additional activities supporting conservation of landbirds on the Refuge Complex include:

- Conduct new surveys and studies for sensitive/declining species (see objective for Threatened and Endangered Species).
- Develop step-down Inventory and Monitoring Plan to guide the Refuge Complex biological program.

3. Fish and other Aquatic Species

The biological program objective for fish and other aquatic species is to ensure healthy populations and document population trends, status and habitat utilization of priority species on the Refuge Complex. A

second objective is to incorporate fisheries and aquatic resource management into the management of all estuarine marshes on the Refuge Complex.

No Change from biological program activities in Refuge Management Alternative A.

4. Threatened and Endangered Species, Species of Conservation Concern

The biological program objective for Threatened and Endangered species, Species of Conservation Concern, and other “watch species” is to support recovery efforts and to obtain information on population trends, status and habitat utilization of sensitive and/or declining species utilizing the Refuge Complex. Eight federally-listed Threatened and Endangered species occur on or adjacent to the Refuge Complex: Bald Eagle, Piping Plover, Brown Pelican, Loggerhead sea turtle, Kemp’s Ridley sea turtle, Green sea turtle, Hawksbill sea turtle, and Leatherback sea turtle. The sea turtles are found offshore in the Gulf and in Galveston Bay, but no nesting on beaches has been documented on the Refuge Complex. The Refuge Complex also provides important habitat for 33 avian species identified by the USFWS as Species of Conservation Concern within the Gulf Prairies Bird Conservation Region. Nine out of the 13 avian species listed by the Texas Parks and Wildlife Department as rare and declining species in coastal prairies and marshes in Texas are found on the Refuge Complex. .

The Texas Parks and Wildlife Department lists three species of reptiles which occur or potentially occur on the Refuge Complex as threatened: the smooth green snake, alligator snapping turtle and the Texas horned lizard. Several additional species of reptiles and amphibians are listed in the Texas Natural Heritage Database, now maintained by The Nature Conservancy’s Texas Conservation Data Center. Little or no information about the relative abundance, distribution and habitat utilization of any of these species on the Refuge Complex is currently available.

USFWS biological program and management activities for Threatened and Endangered species and Species of Conservation Concern under Refuge Management Alternative A would continue. Proposed additional activities supporting conservation of sensitive species on the Refuge Complex include:

- Conduct fall, winter and spring beach and bay surveys on the Refuge Complex for the following priority shorebird and colonial waterbird species: Piping Plover, Snowy Plover, Long-billed Curlew, Wilson’s Plover, American Golden Plover, Short-billed Dowitcher, Reddish Egret, Least Tern, Black Skimmer, and Gull-billed Tern.
- Conduct bi-weekly surveys in marsh and prairie wetland habitats (rice fields, moist soil units) on the Refuge Complex from February to May and July through September, to document relative abundance and habitat utilization and monitor population trends of the following priority shorebird and colonial waterbird species: Buff-breasted Sandpiper, Hudsonian Godwit, American Golden Plover, American Bittern, Least Bittern, Wood Stork.
- Initiate field surveys to monitor population trends of rail species on the Refuge Complex, including yellow rails and black rails.
- Initiate surveys to determine the relative abundance and habitat use of the following priority grassland birds which utilize Refuge Complex habitats during winter and/or migration periods: LeConte’s Sparrow, Sprague’s Pipit, Loggerhead Shrike, White-tailed Hawk, Northern Harrier, and Short-eared Owl.
- Expand Project Prairie Birds monitoring to include salty prairie and marsh habitats.
- Develop and maintain a database which documents the occurrence of rare species on the Refuge Complex.
- Facilitate and support new monitoring/research studies to determine the breeding, migrational and wintering distribution and habitat utilization of Black and Yellow rails.
- Facilitate and support new monitoring/research studies to determine the breeding, migrational and wintering distribution and habitat utilization of American Bitterns.
- Facilitate and support new research studies to determine the effects of prescribed burning and controlled grazing on sensitive or declining avian species.
- Facilitate and support new monitoring/research which evaluates the population status and habitat use of the following sensitive or declining reptile and amphibian species: pig frog, smooth green

snake, alligator snapping turtle, Texas diamondback terrapin, Texas horned lizard, slender glass lizard, and crayfish snake.

- Facilitate and support new research study to determine occurrence, relative abundance and habitat use of Short-eared and Burrowing Owls during wintering and migration periods.
- Facilitate and support new research study to determine relative abundance and habitat use of White-faced and White Ibis on the Refuge Complex.
- Following the successful restoration of coastal prairie habitat on the Refuge, evaluate the potential to reintroduce Attwater's Prairie Chicken on Anahuac NWR.

5. Mammals

The objective for mammals is to document population status and trends and habitat utilization of priority species on the Refuge Complex. Coastal habitats of the Texas Chenier Plain region support a diverse mammalian community.

USFWS biological program activities for mammals under Refuge Management Alternative A would continue. Proposed additional activities supporting conservation of mammals on the Refuge Complex include:

- Initiate monitoring of status and trends of muskrat populations on the Refuge Complex utilizing field surveys and GIS technology.
- Facilitate and supports research/monitoring to document species composition, habitat use and relative abundance of small mammal populations on the Refuge Complex.
- Develop a step-down Nuisance Animal Control Management Plan. Manage muskrat and nutria populations utilizing trapping under Special Use Permit when necessary to prevent damage to emergent marsh habitats. Manage mesopredator populations (raccoons, striped skunk, grey and red foxes) as necessary to reduce predation on Mottled Ducks and their nests, and on other ground-nesting migratory bird species.

6. Reptiles and Amphibians

The biological program objective for reptiles and amphibians is to maintain healthy populations and natural diversity, and to document population status and trends. Within 15 years, the objective for Alligators is to maintain alligator populations at self-sustaining levels, but at densities consistent with migratory bird management objectives. In addition, harvest management will increasingly be directed at maintaining a natural age structure within Refuge Complex alligator populations.

USFWS biological program activities for reptiles and amphibians under Refuge Management Alternative A would continue. Proposed additional activities supporting conservation of reptiles and amphibians on the Refuge Complex include:

- Facilitate and support new surveys and studies for sensitive/declining species (see Threatened and Endangered species, above).
- Facilitate and support baseline monitoring to determine species composition and relative abundance of herptofaunal assemblages across all Refuge Complex habitat types. Baseline information on reptiles and amphibians on the Refuge Complex is lacking.
- Facilitate and support research to determine nesting frequencies of adult female alligators through monitoring of mitochondrial DNA within egg membranes. These data will be used to improve population estimates generated from aerial nest counts.
- Facilitate and support new research to determine the diet of alligators during spring and summer to evaluate influences of predation on Mottled Ducks and other native wildlife. This will be a cooperative project with the Texas Parks and Wildlife Department.

7. Invertebrates

The biological program objective for invertebrates is to maintain healthy populations and natural diversity, and document species occurrence on the Refuge Complex.

No change from biological program activities in Refuge Management Alternative A

8. Plant Resources

The biological program objective for plant resources is to maintain native plant diversity and to document species composition and plant community changes over time on the Refuge Complex. Natural disturbances such as drought and floods, fire and herbivory by wildlife, and management activities such as grazing, prescribed burning, water level and salinity management all impact plant communities on the Refuge Complex. Sea level rise, subsidence and exotic plant and animal species are now also impacting native plant communities. Understanding how these events, processes and management activities affect plant community dynamics is essential to ensure long-term conservation of plant resources.

USFWS biological program activities for plant resources under Refuge Management Alternative A would continue. Proposed additional activities supporting conservation of plant resources on the Refuge Complex include:

- Implement a systematic fire effects monitoring program in representative habitats on the Refuge Complex.
- Facilitate and support new research to determine the effects of fire, fire seasonality and fire intensity on marsh surface elevation change and vegetative response.
- Develop enhanced Geographic Information System capabilities and use in combination with remote imaging data to track and monitor vegetation changes in Refuge Complex habitats.
- Develop and implement step-down Habitat Management Plans for each Refuge.

C. Addressing Threats to the Ecosystem

Under Refuge Management Alternative D, the USFWS would increase efforts aimed at reversing trends of loss and degradation of native habitats by increasing efforts to address the effects of relative sea level rise and reduced sediment supply, altered hydrologic processes, exotic and invasive species and environmental contaminants. These efforts would include expanded coordination with other agencies and conservation organizations with a goal of implementing large-scale shoreline protection and hydrologic and marsh restoration projects. The USFWS would also implement smaller scale erosion abatement projects along the Gulf, Galveston Bay, and the GIWW and hydrologic restoration projects throughout the Refuge Complex.

These efforts addressing threats to ecosystem health focus on achieving the following Refuge goal:

- GOAL 4. By working with others locally and on a landscape level, threats to biological integrity, diversity, and environmental health on the Texas Chenier Plain Refuge Complex will be addressed.

1. Coastal Land Loss

The objective for the threat from relative sea level rise and reduced sediment supply is to decrease rates of coastal land loss due to shoreline erosion along the Gulf of Mexico, East Galveston Bay, and the GIWW. Along the Texas Coast, wetland losses between the mid-1950's and mid-1990's were most substantial for estuarine emergent marshes (Moulton *et al.* 1997). Relative sea level rise and reduced coarse sediment supply to Gulf and bay nearshore littoral systems are resulting in significant loss of coastal habitats. Average rates of shoreline retreat along the Gulf adjacent to the refuges are as high as 50 feet per year on Texas Point NWR, and 10-15 feet per year along most of McFaddin NWR (Bureau of Economic Geology unpublished data, Morton 1998). Over 800 acres of dunes and emergent marsh has been lost due to Gulf shoreline erosion on these refuges during the last 25 years, and remaining inland

marshes are increasingly threatened by more frequent inundation during high tidal events. Although less severe, erosion along the East Galveston Bay shoreline is also causing wetland loss on Anahuac NWR, and also threatens remaining marshes with saltwater intrusion. Erosion along the GIWW is also causing direct loss of wetlands and poses a significant threat to marshes from saltwater intrusion on both McFaddin and Anahuac NWRs. Levees created when the GIWW was constructed have almost entirely eroded away along significant portions of its length within these refuges.

Current USFWS efforts to address threats from relative sea level rise and reduced sediment supply would continue as in Refuge Management Alternative A. Proposed additional activities and modifications include:

- Increase coordination with the U.S. Army Corps of Engineers, National Marine Fisheries Service, Texas General Land Office, Texas Parks and Wildlife Department, Galveston Bay Estuary Program, Texas Department of Transportation and other local, state and federal agencies to develop and implement long-term inter-jurisdictional strategies to reduce coastal land loss along the Gulf of Mexico, East Galveston Bay and the GIWW. Goals would include implementing major projects to restore the Gulf barrier beach/dune complex on McFaddin NWR (dependent upon the results of ongoing sand source investigations, possibly using off-shore sand supplies), to restore sediment supply to the Gulf's nearshore littoral zone on Texas Point NWR through the beneficial use of dredge material, and to construct structural protection (rock breakwaters) and restore emergent marshes along shorelines of Galveston Bay (Anahuac NWR) and the GIWW (Anahuac and McFaddin NWRs).
- Participate in U.S. Army Corps of Engineers new Regional Sediment Management program.
- Increase coordination among state, federal and local agencies on the issue of relative sea level rise and promote advanced conservation planning to address threats.
- Develop partnerships with universities and the U.S. Geological Survey, and facilitate and support new research and monitoring on marsh accretion and its relation to management practices including burning and structural marsh management.
- Install an additional 7,500 linear feet of shoreline erosion abatement (offshore rock wave breaks) and restore 10 acres of under shore emergent marsh (smooth cordgrass plantings) along East Galveston Bay shoreline on Anahuac NWR. Install 10,000 linear feet of shoreline protection along the GIWW on Anahuac NWR.
- Restore an additional 5,000 linear feet of the dunes along the Gulf of Mexico on McFaddin NWR.
- Protect an additional 10,000 linear feet of GIWW shoreline on McFaddin NWR using offshore wave breaks, shoreline armoring, and/or emergent plantings (smooth cordgrass).
- Increase coordination with landowners, USFWS Partners for Fish and Wildlife and Coastal programs to enhance shoreline protection on Moody NWR.

2. Altered Hydrologic Processes

The objective for the threat from altered hydrologic processes and resulting interior marsh loss is to protect existing and restore emergent coastal marsh habitat on the Refuge Complex by reducing saltwater intrusion, increasing freshwater and inflows and mineral sediment supply to marshes, and maintaining natural marsh hydroperiods. Land subsidence and sea level rise, channel construction, and channelization of natural waterways has had significant hydrologic impacts including saltwater intrusion, increased tidal energies causing erosion of organic marsh substrates, loss of freshwater inflows and reduced mineral sediment supply to marshes, and excessive flooding or drainage/drying of marshes. Over the last century, these factors have gradually converted extensive areas of fresh and intermediate marshes to a more brackish regime thereby decreasing natural biological diversity, and in some areas have resulted in conversion of vegetated emergent marshes to open water (marsh loss). Relative sea level rise further threatens vegetated marshes through increased saltwater intrusion and submergence. To survive, remaining marshes must accrete or gain elevation at a rate that keeps up with relative sea level rise. Maintaining plant productivity and preventing loss of organic marsh soils by restricting saltwater intrusion and tidal energies, increasing freshwater inflows, and beneficially using dredge materials to increase mineral sediment supply appear to offer the most realistic options for reversing current trends of interior marsh loss in the Chenier Plain region.

USFWS activities addressing altered hydrologic processes in Refuge Management Alternative A would continue. Proposed additional activities and modifications include:

- Expand coordination with local, state and federal agencies to develop and implement watershed-scale hydrologic restoration project. A key component would be assessing the feasibility of and identifying options for restoring freshwater inflows to coastal marshes within the Salt Bayou watershed south of the GIWW.
- Expand coordination with the U.S. Army Corps of Engineers, Texas General Land Office, Texas Parks and Wildlife Department, Texas Department of Transportation and other local, State and Federal agencies to develop strategies to restore and enhance wetlands on the Refuge Complex through the beneficial use of dredged materials. This will include participating in the U.S. Army Corps of Engineers new Regional Sediment Management program.
- Develop partnerships with universities and the U.S. Geological Survey, and facilitate and support new research and monitoring on marsh accretion and its relation to management practices including burning and structural marsh management.
- Monitor status and trends of Refuge Complex wetlands on all four refuges through enhanced Geographic Information System capabilities.
- Research the availability of, and if possible, acquire additional water rights to facilitate increasing freshwater inflows to the Anahuac NWR's East Unit from East Bay Bayou and Onion Bayou and to the Middleton Tract from Elm Bayou.
- Coordinate with Trinity Bay Conservation District and other partners to repair saltwater barriers and water control structures on East Bay, Elm and Onion bayous on Anahuac NWR and on the Moody NWR.
- On Anahuac NWR, construct a passive overflow spillway structures East Bay and Elm bayous to restore over bank flooding and freshwater inflows into East Unit and Middleton Tract marshes.
- On Anahuac NWR, construct rock weirs in constructed channels in northern portion of Pace Tract to reduce saltwater intrusion and decrease tidal energies.
- On Anahuac NWR, enhance water management by replacing water control structures and restoring levees along East Bay Bayou on the East Unit and Middleton Unit.
- On McFaddin NWR, restore hydrology by reducing saltwater intrusion and restoring marsh hydroperiods through construction of rock weirs and/or earthen plugs in constructed channels in the Willow/Barnett Lake Unit.
- Research the availability of and need for acquiring water rights to ensure that freshwater inflows remain adequate to maintain the natural diversity and productivity of the Willow Slough marsh on the McFaddin NWR North Unit.
- Restore natural hydrology to western marshes on McFaddin NWR by restoring Mud Bayou to its historic dimensions through construction of a rock weir.
- Coordinate with state and federal agencies and others to develop and implement a comprehensive hydrological restoration on Texas Point NWR. Reducing saltwater intrusion and tidal energies by restoring Texas Bayou to historic dimensions and reducing the influence of constructed channels will be key components of this project.
- On Moody NWR, increase coordination with landowners, other USFWS divisions and state and federal agencies to restore hydrology by reducing saltwater intrusion.
- Throughout the Refuge Complex, restore surface hydrology by removing barriers formed by abandoned roads, levees and well pads remaining from past oil and gas development and agricultural activities.

3. Invasive Species

The objective for the threat invasive species is to, utilizing Integrated Pest Management strategies, implement a comprehensive invasive species (exotic and native species) control program which will: 1) reduce current infestations by 50% within 15 years; and 2) prevent any new infestations. Monocultures of exotic and invasive plants reduce natural biological diversity, increase erosion, alter nutrient cycling and displace macro- and micro-fauna that depend on native plants for habitat and food (Sheley and Petroff 1999). Refuge habitats are currently significantly impacted by exotic plants and animals including:

Chinese tallow (*Sapium sebiferum*), water hyacinth (*Eichhornia crassipes*), alligator weed (*Alternanthera philoceroides*), water lettuce (*Pistia stratiotes*), McCartney rose (*Rosa bracteata*), vasey grass (*Paspalum urvillei*), Johnson grass (*Sorghum halepense*), *Cyperus entrerianus*, Eurasian water milfoil (*Myriophyllum spicatum*), hydrilla (*Hydrilla verticillata*), *Salvinia minima*, Japanese honeysuckle (*Lonicera japonica*) red imported fire ants, nutria, and feral hogs. Giant salvinia (*S. molesta*), to date documented on the Refuge Complex only once and in small amounts near a refuge boat ramp, has been found nearby and poses a significant threat to freshwater wetlands. Invasive native plant species include eastern baccharis (*Baccharis halimifolia*), big-leaf sumpweed (*Iva frutescens*), rattlebox (*Sesbania drummondii*), common reed (*Phragmites communis*) and cattail (*Typha* spp.).

USFWS efforts addressing invasive species in Refuge Management Alternative A would continue. Proposed activities through an expanded Integrated Pest Management program include:

- Throughout the Refuge Complex, expand field monitoring to provide early detection of new infestations, and develop enhanced GIS capabilities to map existing and new stands of upland and aquatic invasive plants.
- Develop new partnerships with universities and the U.S. Geological Survey Biological Resources Division to evaluate invasive species control strategies.
- On Anahuac NWR, evaluate control strategies for deep-rooted sedge and several exotic grasses including the newly discovered King Ranch bluestem currently impacting upland prairie habitats.
- On Anahuac NWR, mechanically remove Chinese tallow along the GIWW, Oyster Bayou, East Bay Bayou, Onion Bayou, and State Highway 124.
- On Anahuac NWR, increase coordination with the Trinity Bay Conservation District and the Chambers-Liberty Counties Navigation District on control of aquatic and terrestrial invasive plants on waterways, canals and ditches and on banks and levees within drainage and irrigation easements throughout the Anahuac NWR.
- Evaluate use of approved and permitted biological control agents as they become available, for use in IPM program for invasive species control. An approved biological control agent for *Salvinia* spp. is now available for release in Texas, and its use on the Refuge Complex will be evaluated.
- Expand integrated control activities for water hyacinth in the Willow Slough Marsh on the North Unit of McFaddin NWR.
- On Texas Point NWR, utilize spot herbicide treatments to control McCartney rose on non-saline prairie habitats.
- On the Refuge Complex, expand control efforts for invasive emergent marsh plants such as cattail and common rush where encroachment has resulted in loss of desirable open water habitats.
- Develop exotic aquatic plant interpretive signs and install them at all Refuge Complex boat ramps.
- Develop step-down Feral Hog Management and Nuisance Animal Management plans. Expand control efforts for feral hogs and nutria as necessary.

4. Contaminants

The objective for the threat from contaminants is to, within 15 years, identify and monitor all potential point and non-point source pollution impacts to the Refuge Complex and develop a strategy to clean up contaminants and protect refuge resources from those impacts. Contaminant issues affecting the Refuge Complex include potential petroleum and petrochemical spills from: 1) on-Refuge oilfield operations; 2) shipping on the GIWW; and 3) offshore production in the Gulf. The potential for petrochemical and petroleum spills affecting the Refuge Complex is high. Over 20 active oil and gas wells are currently producing on the Refuge Complex. Significant drilling and production activity occurs in Gulf waters offshore of McFaddin and Texas Point NWRs. The GIWW between Houston and Lake Charles, Louisiana is one of the busiest reaches of this waterway for shipping petrochemical and petroleum products. The GIWW parallels much of McFaddin and Anahuac NWRs, and the Sabine-Neches Ship Channel parallels Texas Point NWR. Former and current oil and gas production areas on the Refuge Complex contain extensive infrastructure which is no longer in use, including flow lines, pipelines, oil pits,

well pads, and brine disposal areas. Many of these lines, pits, and pads may contain contaminants including heavy metals, normal occurring radio-active material, brine, and petroleum products. In addition, Refuge Complex marshes comprise the downstream end of at least 10 waterways. Factories, refineries, solid waste disposal sites, oil field sludge disposal areas, feedlot operations, agricultural operations and housing developments are potential pollution sources in upstream reaches of these watersheds. Finally, spent lead shotgun pellets may still pose a threat to waterfowl and other wildlife in the region. Incidence of lead shot in Mottled Duck gizzards remains relatively high to the present in birds harvested on the Anahuac and McFaddin NWRs, even after over 15 years of implementation of non-toxic ammunition regulations.

Current USFWS activities addressing threats from contaminants in Refuge Management Alternative A would continue. Proposed additional activities include:

- Develop a comprehensive spill response plan for incidents occurring off-refuge which threaten Refuge Complex resources.
- Increase coordination with the interagency spill response programs. Integrate Refuge Complex spill response activities with interagency programs.
- Assemble and maintain a qualified first responder team comprised of Refuge Complex staff through training and participation in interagency spill response drills.
- Throughout the Refuge Complex, conduct contaminant investigations in current and former oil and gas production areas and develop clean up plans for any contaminated areas which pose threats to habitats and fish and wildlife resources.
- Conduct a thorough inventory and assessment of abandoned oil and gas infrastructure on the Refuge Complex, and develop plans for removal of abandoned facilities and habitat restoration.
- Facilitate and support water quality monitoring in Taylors Bayou, Willow Slough, Spindletop Bayou, Mud Bayou, Oyster Bayou, Robinson Bayou, East Bay Bayou, Onion Bayou, Elm Bayou and the GIWW.
- Facilitate and support field assessment to identify any potential “hot spots” of lead contamination on the Refuge Complex. Develop and implement management actions for remediating any areas with high levels of lead.

5. New Oil and Gas Exploration and Development

Minerals underlying the refuges are privately held and the USFWS must allow reasonable use of the surface of refuges to explore for and develop oil and gas reserves. The objective for managing new oil and gas exploration and development is to ensure that new oil and gas exploration and development on the Refuge Complex is conducted in the most environmentally-sensitive manner possible by defining a process which facilitates close coordination with industry and timely processing of requests to conduct activities, and which mandates the use of scientifically-accepted “best management practices” for these activities in sensitive coastal environments.

Current USFWS activities addressing new oil and gas development in Refuge Management Alternative A would continue. Proposed additional activities would include:

- Develop a step-down Oil and Gas Management Plan for the Refuge Complex.
- Establish an Oil and Gas Management Specialist position.

D. USFWS Public Use Program

The Texas Chenier Plain Refuge Complex offers a wide variety of recreational opportunities and received over 172,000 visitors during Fiscal Year 2002. Through the use of existing programs and facilities, the Refuge Complex provides opportunities for all six of the Refuge System’s priority wildlife-dependent recreational uses, which are:

- Hunting
- Fishing
- Wildlife Observation and Photography
- Environmental Education and Interpretation

These visitor and recreational opportunities focus on achieving the following Refuge goal:

- GOAL 5. All local, national and international visitors will enjoy safe and high quality outdoor experiences on the Refuge Complex, and learn of the Refuge Complex' role in conserving the region's coastal natural resources. New partnerships with our local communities will be forged to highlight, promote and conserve the unique natural assets of the upper Texas Gulf Coast

Development of new public use program facilities and programs will focus on partnership opportunities with local, county and state agencies and with our Refuge Friends groups and other conservation and outdoor recreation organizations.

1. Hunting

The objective for hunting is that, within 15 years, 90% of all hunting visits on the Refuge Complex will qualify as high-quality hunting experiences. Waterfowl hunting is a traditional and still very popular outdoor recreational pursuit in the region. Refuges and other public lands along the Gulf Coast play a key role in providing hunting opportunity to the public at large. Due to the remoteness and wetland environment of these refuges, hunting access is challenging and is a key factor when providing for hunting opportunities. Improving and managing hunting access will facilitate high-quality hunting experiences. Providing more information to hunters, increasing "designated hunt area" opportunities to reduce crowding problems, and providing additional hunting opportunities will also contribute to an overall high-quality hunting experience.

We define "a high-quality hunting experience" as one that: 1) promotes safety of participants, other visitors, and facilities; 2) promotes compliance with applicable laws and regulations and responsible behavior; 3) minimizes or eliminates conflict with fish and wildlife population or habitat goals or objectives in an approved plan; 4) minimizes or eliminates conflicts with other compatible wildlife-dependent recreation; 5) minimizes conflicts with neighboring landowners; 6) promotes accessibility and availability to a broad spectrum of the American people; 7) promotes resource stewardship and conservation; 8) promotes public understanding and increases public appreciation of America's natural resources and our role in managing and conserving these resources; 9) provides reliable/reasonable opportunities to experience wildlife; 10) uses facilities that are accessible to people and blend into the natural setting; and 11) uses visitor satisfaction to help define and evaluate programs.(USFWS Service Manual 605 FW 1).

Our objective will be met if 90% or more of hunting visits meet the standards set for a high-quality hunting experience, as determined annually by hunter comments collected by the check station operator. As such, 1) less than 10% of hunters will report feeling unsafe; 2) less than 10% of hunters will report feeling crowded; 3) no hunter will report unfairness in obtaining access to hunt; 4) less than 5% of hunters contacted will be cited for hunting violations during routine enforcement; and 5) there will be no hunting-related safety incidents.

Current USFWS public use program activities in support of hunting in Refuge Management Alternative A would continue; with the development of the following additional facilities and programs:

- Construct foot bridges across Onion Bayou and over canals to the North Reservoir on the East Unit of Anahuac NWR.
- Enhance boat access within Anahuac NWR's East Unit and the Middleton Tract Unit through improved maintenance of access ditches.
- Provide additional "Designated Hunt Areas" on a first-come, first-serve on the East Unit of Anahuac NWR.
- Open designated portion of the Anahuac NWR East Unit during the September teal season.
- Open designated area(s) on Anahuac NWR to dove hunting, potentially through implementation of a Cooperative Agreement with the Texas Parks and Wildlife Department to include open areas in their "Short Term Public Hunting Lease Program."
- Install information kiosks at the Oyster Bayou boat ramp, providing orientation map to hunting units, access points, hunt regulations, and safety information on Anahuac NWR.

- Develop directional signage to refuge hunting areas for hunters accessing the Anahuac NWR via navigable waters.
- Improve the Boat Canal/Oyster Bayou boat launch and parking area on Anahuac NWR.
- Provide seasonally-open primitive access (4-wheel drive trail) on the Gulf of Mexico beach ridge on McFaddin NWR (permanent or temporary action dependent upon ultimate disposition of State Highway 87 project), for access to hunt areas during waterfowl seasons.
- Reduce conflicts between waterfowl hunters on the Star Lake/Clam Lake Hunt Unit during the regular waterfowl season by requiring all hunters hunting this unit to register at the check station, including those accessing the unit from the beach along the Brine Line or Perkins Levee. All hunters accessing Star Lake and associated waters via boat must access via the Refuge's Star Lake boat launch.
- Provide additional "designated hunt area" duck hunting opportunities on McFaddin NWR.
- Maintain the shallow ditch system for boat access from the GIWW within the Central Hunt Unit of McFaddin NWR.
- Construct a new hunter check station at McFaddin NWR.
- Install an information kiosk at McFaddin and Texas Point NWRs providing orientation map to hunting units, access points, hunt regulations, and safety information.
- Develop improved boat access off the GIWW to the McFaddin NWR Central Hunt Unit.
- Develop detailed step-down Hunt Management Plans for the Anahuac, McFaddin and Texas Point refuges.
- Revise the hunting permit fee system to provide for a Refuge Complex-wide annual waterfowl hunting permit.
- Develop an Internet-based system for obtaining fee area hunting permits.
- Improve public safety and education and outreach with an expanded and enhanced law enforcement program.
- Develop and produce hunting area maps that provide detailed information on locations, access, special features, safety and ethical behavior.
- Within 5 years, implement a 25-hp restriction on inland waters in designated Hunt Units on Anahuac, McFaddin and Texas Point NWRs to improve public safety and protect habitats.

2. Fishing

The objective for fishing is that, within 15 years, 90% of all fishing visits on the Refuge Complex will qualify as high-quality fishing experiences, as determined by angler comments documented during routine visitor contacts. The Refuge Complex offers exceptional recreational fishing and crabbing opportunities in both saltwater and freshwater environments. Catfish, bass and brim in freshwater environments and speckled trout, flounder and red drum in saltwater environments are among the popular game fish species on the refuges. Crabbing for blue crabs is also a popular recreational pursuit along refuge waterway and lake shorelines. Improving access for fishing and providing additional education on fishing and fishing opportunities on the Refuge Complex will help facilitate high-quality fishing experiences.

We define a high-quality fishing experience as one that: 1) is available to a broad spectrum of the fishing public; 2) provides an opportunity to use various angling techniques; 3) provides opportunities in both freshwater and saltwater environments; and 4) reflects positively on the individual Refuge, the Refuge System and the USFWS.

Current USFWS public use program activities in support of fishing in Refuge Management Alternative A would continue; with the development of the following additional facilities and programs:

- On Anahuac NWR, improve access for fishing on East Galveston Bay by constructing a boardwalk from Frozen Point Road to the Bay.
- Develop walk-in access for fishing at Coon Creek, Oyster Bayou, and between Shoveler Pond and Westline Road on Anahuac NWR.
- Extend open hours on McFaddin NWR (designated areas accessible via Clam Lake Road) to one hour before sunrise to one hour after sunset on weekdays and open this portion of the Refuge on

weekends to facilitate additional recreational fishing and other wildlife-dependent recreational opportunities.

- On McFaddin NWR, construct additional fishing facilities including a fishing/crabbing pier on 10-Mile Cut/Clam Lake, boat launch and parking facilities on 10-Mile Cut and fishing platform on Star Lake.
- Develop freshwater fishing opportunities in Pond 13 on McFaddin NWR.
- Coordinate and partner with local, county and state agencies to improve a primitive boat launching area off Pilot Station Road in Sabine Pass, to improve boat access to Texas Bayou and Texas Point NWR.
- Develop step-down Fishing Plans for the Anahuac, McFaddin and Texas Point NWRs.
- Develop a brochure clearly defining fishing areas, including maps of access points for fishing opportunities, regulations and providing information on some of the more popular game fish species.
- Develop Internet-based availability of fishing information.

3. Wildlife Observation and Photography

The objective for wildlife observation and photography is to, within 15 years, provide Refuge Complex visitors with several new high quality opportunities to view and photograph wildlife in managed and restored habitats. Because overall management of the Refuge Complex under this Alternative will emphasize active habitat management and habitat restoration, new wildlife viewing and photography opportunities would be developed for both managed and restored habitats such as marsh semi-impoundments and moist soil units, and in restored native habitats including wetlands, prairies and woodlots. These facilities will improve viewing opportunities for wetland-dependent migratory birds, grassland birds and neotropical migratory birds, butterflies and other native wildlife.

The Refuge Complex provides local, regional, national and international visitors with a wide range of wildlife observation and photography opportunities, supporting a rapidly growing nature tourism industry in Texas. Migratory bird and alligator viewing are the main attractions. The refuges are highlighted Upper Texas Gulf Coast sites on the Great Texas Birding Trail. Anahuac NWR is an internationally known birding destination, receiving visitors each year from all 50 states and over 20 countries.

Current USFWS public use program activities in support of wildlife observation and photography in Refuge Management Alternative A would continue; with the development of the following additional facilities and programs:

- Complete the butterfly habitat and native habitat demonstration area adjacent to the Anahuac NWR Visitor Information Station.
- On Anahuac NWR, construct a new observation platform overlooking the Oyster Bayou Moist Soil Units, and construct a tree-canopy height observation platform on the East Bay Bayou Trail.
- Develop a levee trail and boardwalk for wildlife observation near the Refuge Headquarters on McFaddin NWR.
- Construct a parking area and observation platform at the McFaddin NWR Clam Lake Road entrance.
- Maintain a seasonal levee trail along Perkins Levee outside of the waterfowl season on McFaddin NWR.
- Construct a photography blind on McFaddin NWR.
- Develop a self-guided canoe and kayak trail along 10-Mile Cut from McFaddin NWR to Sea Rim State Park.
- Develop a self-guided canoe and kayak trail on East Bay Bayou on Anahuac NWR.
- Construct a connecting trail and observation platform on Texas Point NWR.
- Institute an entry fee program at Anahuac NWR (see below) for refuge visitors, available as day passes or annual entry permits (Refuge Complex annual hunting permit will also serve as annual entry permit).
- Develop step-down Wildlife Observation and Photography Plans for the Anahuac, McFaddin and Texas Point NWRs.

The Anahuac NWR was approved for the collection of a general entrance fee (for that portion of the Refuge which is open to the public 365 days per year) under the Recreation Fee Demonstration Program (Fee Demo Program) in 1997. In addition to collecting a general entrance fee, the Refuge concurrently proposed to make an annual \$40 permit for waterfowl hunting on the East Unit hunt unit available to refuge hunters (as an option in addition to the existing \$10 per day user fee). Participation by the Service in the Fee Demo Program was authorized under the Omnibus Consolidated Recission and Appropriations Act (P.L. 104-154) of 1996. This law was superceded by the passage of the Federal Lands Recreation Enhancement Act in 2004, which rolled all approved programs under the Fee Demo Program into the new Recreation Fee Program. Although the Refuge was approved to collect both the entrance fee and the annual hunting permit fee under the Fee Demo Program in 1997, to date only the East Unit annual waterfowl hunting permit has been implemented. The goals of initiating an entrance fee on Anahuac NWR would be to continue to enhance the experience of refuge visitors and to expand wildlife-dependent recreational and educational opportunities. Specifically, Refuge entrance fees would be used to help maintain and expand existing visitor facilities and programs, as well as to develop new facilities and programs, including trails, boardwalks, observation platforms and photography blinds, fishing piers, and environmental education and interpretive materials and programs.

4. Environmental Education and Interpretation

The objective for environmental education and interpretation is that, within 15 years, 90% of visitors will feel that they have increased their knowledge of native fish, wildlife and plants and of the Refuge Complex's role in conserving these resources through habitat management and restoration and addressing threats to ecosystem health. Because overall management of the Refuge Complex under this Alternative will emphasize active habitat management, native habitat restoration, and addressing threats to ecosystem health, educational and interpretive programs and materials would focus on managed and restored habitats, management and restoration methodology, and the fish, wildlife and plant species they support. Educating visitors about the importance of our coastal resources and on the role of the Refuge Complex in managing, restoring and maintaining biological integrity and biological diversity will lead to support and responsible stewardship action.

The implementation of environmental education and interpretive programs for students and visitors on the Refuge Complex is important to increase the quality of the visitor experience and to further public awareness of the benefits, issues and challenges associated with natural resource conservation in this productive and diverse coastal ecosystem. Many excellent opportunities exist to expand partnerships with local school districts to incorporate environmental education in their science curricula.

Current USFWS public use program activities in support of environmental education and interpretation in Refuge Management Alternative A would continue; with the development of the following additional facilities and programs:

- Construct Refuge Complex Administrative Headquarters and Wildlife Interpretive Center in Chambers County.
- Complete interpretive facility development in the Anahuac NWR Visitor Information Station including: 1) two interactive multi-media audio-visual programs; 2) digital imaging displays of coastal habitats and fish and wildlife species representing all four seasons; and 3) a hanging display of life-sized marsh and waterbird carvings.
- Develop interpretive exhibits for the Anahuac NWR butterfly habitat and native prairie demonstration site, including exhibits which highlight native butterflies and native plants which provide important habitat for butterflies.
- Develop interpretive exhibits on waterfowl and waterfowl management for the East Unit Hunter Check Station of Anahuac NWR.
- Initiate weekly interpretive walks during spring, focusing on butterfly identification and habitat use on Anahuac NWR.
- Construct an interpretive kiosk at the East Bay Bayou Tract trailhead, and produce self-guided brochure/trail guide for East Bay Bayou Tract on Anahuac NWR.

- Conduct naturalist-led interpretive walks during fall and winter on Anahuac NWR, focusing on wintering waterfowl and the habitats they utilize.
- Develop 4 mobile interpretive displays on 1) habitat management practices for waterfowl, shorebirds, and other wetland-dependent migratory birds; 2) native coastal prairie and prairie restoration; 3) coastal woodlots; and 4) fire ecology.
- Develop interpretive signs on native habitats including coastal wetlands, coastal prairie, and coastal woodlots and the wildlife species they support, and strategically place throughout the Refuge.
- Develop interpretive exhibits on wetland and upland habitat management practices including prescribed burning, controlled grazing, water management and exotic species control and strategically place throughout the Refuge
- Develop interpretive signs for the Anahuac NWR Oyster Bayou Moist Soil Unit overlooks, emphasizing waterfowl and shorebird ecology and moist soil management.
- Install a microwave video camera in the field to project images of “real time” nature back to the Anahuac NWR Visitor Information Station and/or the Friends of Anahuac Refuge Web page.
- For Anahuac NWR, develop and produce a “Children’s Checklist” of common refuge plant, animal and fish species.
- Develop a self-guided radio interpretive program for the Willows- Shoveler Pond - Frozen Point auto tour route on Anahuac NWR.
- Develop a brochure on the role of fire in marsh and prairie ecology and its use as a management tool on the Refuge Complex.
- Develop interpretive facilities on McFaddin and Texas Point NWRs (kiosks, signage) to interpret coastal marsh and coastal woodlot habitats and native fish and wildlife resources.
- Develop interpretive exhibits on waterfowl and waterfowl management for the McFaddin NWR check station.
- Produce a video detailing the natural resources of the Chenier Plain region and the role of the Refuge Complex in conserving these resources.
- Revise the two refuge general brochures and websites to detail each Refuge’s role in managing and restoring native habitats and fish, wildlife, and plants.
- Develop presentations on wildflowers, butterflies, mammals and reptiles and amphibians found on the Refuge Complex.
- On Anahuac NWR, expand the environmental education program to include an advanced independent projects program for local scouting and 4H groups, an educational activity for middle school and high school students describing neo-tropical migratory bird migration and the importance of protecting breeding, wintering and stopover habitat. The activity would include a classroom session followed by a field trip to the Refuge during spring migration.
- On McFaddin and Texas Point NWRs, develop and initiate an on-refuge Environmental Education program for Sabine Pass schools and students.
- Develop step-down Environmental Education and Interpretation Plans for the Anahuac, McFaddin and Texas Point NWRs.

5. Beach Uses on McFaddin NWR

The objective for beach uses on McFaddin NWR is to protect public safety and natural resources along the Gulf of Mexico shoreline within the refuge. The beaches along the Gulf of Mexico on and adjacent to the McFaddin NWR support recreational uses including surf fishing, swimming, sunbathing, wildlife observation, and camping. The beaches on McFaddin NWR are considered an area of joint Federal and State of Texas jurisdiction. The beach inland of the Mean High water line lies within the Refuge. Motorized vehicular traffic occurs on the beach from the vegetation line seaward to mean low tide line, on the public beach easement established under the State of Texas “Open Beaches Act” (Texas Natural Resources Code, Chapter 61: Use and Maintenance of Public Beaches).

Current USFWS public use program activities related to beach use on McFaddin NWR under Refuge Management Alternative A would continue. Proposed additional USFWS activities include:

- Expand law enforcement activities to protect public safety and natural resources.
- Expand coordination with the Texas General Land Office and county agencies to enhance protection of public safety and natural resources.

E. Community Outreach and Partnerships

The objective for community outreach and partnerships is to promote conservation of natural resources on a landscape scale by working effectively with partners in support of USFWS management programs on the Refuge Complex, and by supporting community-based conservation and development of nature tourism opportunities region-wide. Partnerships with the Friends of Anahuac Refuge and the McFaddin and Texas Point Refuges Alliance, two citizen support groups, with state agencies such as the Texas Parks and Wildlife Department, the Texas General Land Office and the Galveston Bay Estuary Program, and with conservation organizations such as the Galveston Bay Foundation and local Audubon Society chapters have been particularly effective. Volunteers on the Refuge Complex provide over 10,000 hours of service annually. In addition the USFWS is working with private landowners to enhance or restore coastal marsh and prairie wetlands habitat on private lands, by providing technical assistance and helping to coordinate use of several private lands programs (such as the USFWS Partners for Fish and Wildlife Program and the multi-partner Texas Prairie Wetland Project). Many private lands in the region are successfully managed to provide habitat for wintering waterfowl and other migratory birds. The objective for Private Lands Partnerships is to, within 15 years, enhance or restore 1500 acres of coastal marsh and prairie wetlands habitat, 500 acres of coastal prairie habitat, and 10 acres of woodlot habitat on private lands in the Texas Chenier Plain region through coordination with interested private landowners and the use of USFWS private lands programs. Many private lands in the region are skillfully managed to provide habitat for wintering waterfowl and other migratory birds. Excellent opportunities and much interest among landowners exist to enhance, restore and manage wetland, grassland and woodlot habitats on private lands. A variety of private lands programs are available to private landowners to enhance fish and wildlife habitat.

Current USFWS community outreach and partnership activities in Refuge Management Alternative A would continue, with the following efforts to expand community outreach and partnerships with private landowners to enhance upland habitats:

- Work with the Friends of Anahuac Refuge and the McFaddin and Texas Point Refuges Alliance to increase volunteerism and other partnership endeavors.
- Develop a “Refuge Update” news article, to be published regularly in local newspapers.
- Expand coordination with county agencies, Chambers of Commerce, nature tourism organizations and others to promote the outdoor recreational opportunities available on the Refuge Complex through mutual information sharing, development of promotional materials, and other partnership endeavors.
- On Anahuac NWR, hold three on-refuge workshops for private landowners and other agency personnel to demonstrate marsh management and restoration, prairie and woodlot restoration, moist soil management, and other wetland management techniques, and to highlight available USFWS private lands programs and grant opportunities.

F. Administration and Staffing

In addition to the already existing staff positions under Refuge Management Alternative A, staffing on the Refuge Complex would be expanded by seven positions during the 15-year planning horizon of the CCP. This would include six positions previously established by the USFWS as Essential Staffing on the Refuge Complex: 1) Wildlife Biologist; 2) Plant Ecologist; 3) Geographic Information Systems - Computer Specialist; 4) Natural Resource Specialist - Oil and Gas Management; 5) Refuge Operations Specialist; and 6) Heavy Equipment Operator. In addition, one Refuge Law Enforcement Officer position would be established to increase protection of refuge resources and public safety.

V. REFUGE MANAGEMENT ALTERNATIVE E - EMPHASIS ON A PASSIVE MANAGEMENT APPROACH

Alternative E Concept

Management Focus

Under this Alternative, the Refuge Complex would change its management focus from active habitat management and restoration to a more passive management approach, in which plant communities and wildlife populations are influenced primarily by natural events such as lightning-caused fires, herbivory by native wildlife, and tidal or stream flooding.

Active habitat management and restoration activities including prescribed burning, controlled cattle grazing, rice farming and moist soil management would be discontinued. Natural wildfire starts would be allowed to burn until naturally extinguished, with suppression occurring only to protect refuge facilities, adjacent private property, and/or public safety. Management of water levels and salinities through active manipulation of water control structures would be discontinued. Water management infrastructure including levees, delivery and drainage systems and water control structures would be removed over time.

Efforts to address threats to ecosystem health would focus on monitoring rather than active restoration or protection. By working with the scientific and academic communities and other agencies, monitoring programs would be implemented to document shoreline changes and land loss rates along the Gulf, GIWW and East Galveston Bay, changes in plant communities associated with salinity regimes created under passive management, plant community and fish and wildlife population changes caused by the spread of invasive species present or through the establishment of new species, and to track contaminant levels in fish and wildlife, water, soil and air.

The Refuge Complex would continue to provide opportunities for all six of the National Wildlife Refuge System's priority wildlife-dependent recreational uses: hunting, fishing, wildlife observation and photography, and environmental education and interpretation, but administrative oversight and management would occur at reduced levels. Areas open to waterfowl hunting would remain open on strictly a first-come, first-serve basis. Wildlife observation, photography, environmental education and interpretation programs and facility development would be aimed primarily at providing self-guided opportunities.

Implementing Refuge Management Alternative E would involve downsizing the Refuge Complex staff by 12 full-time positions.

Rationale for this Management Focus

The coastal marshes, prairies and woodlots of the Chenier Plain region of southwestern Louisiana and southeast Texas comprise a hemispherically important biological area. The Refuge Complex' coastal marshes host hundreds of thousands of wintering and migrating Central Flyway waterfowl, shorebirds, wading birds and other wetland-dependent migratory birds. Coastal prairie and coastal woodlots on the Refuge Complex support over 150 migratory and resident land bird species, including 9 species of grassland birds and 7 species utilizing woodland habitats listed as Rare and Declining within the Coastal Prairies Region in Texas (Texas Parks and Wildlife Department 2000). Overall, wetland, prairie and woodland habitats on the Refuge Complex provide habitat for 33 Avian Species of Conservation Concern in the Gulf Prairies Bird Conservation Region (under the North American Bird Conservation Initiative).

The high degree of alteration in this ecosystem has resulted in loss and degradation of native habitats and loss of biological diversity. Alterations of historic hydrology including loss of freshwater inflows and increased saltwater intrusion, coastal erosion, land subsidence and sea level rise are contributing to ongoing coastal marsh loss and degradation. Almost all of the region's historic native tallgrass coastal prairie and its associated prairie wetlands have disappeared, and remaining coastal woodlots are

imminently threatened by development and other land use changes. Several highly invasive exotic plant species are replacing native habitats and severely impacting native biological diversity. Air and water quality issues in the region pose a potential contaminant threat to fish and wildlife, as do accidental spills and discharges from the major petrochemical shipping, storage and processing facilities located in close proximity to sensitive wetland habitats on the Refuge Complex.

Conservation of fish, wildlife and plant resources on the Refuge Complex under this Alternative would rely primarily on protecting existing wetland and upland habitats from land use changes such as development and reducing disturbance impacts from human presence. This level of protection could be afforded using less staff and financial resources.

A. USFWS Habitat Management and Restoration

Conservation and improvement of refuge habitats is largely accomplished by influencing the vegetation resources found on the different habitat types. Under Refuge Management Alternative E, the current habitat management activities consisting of water management, controlled grazing/mowing, prescribed burning, and other management or restoration activities would be discontinued in favor of a more passive management. Under this Alternative, plant communities and wildlife populations are influenced primarily by natural events such as lightning-caused fires, herbivory by native wildlife, and tidal or stream flooding.

This habitat management approach would focus on achieving the two following Refuge goals:

- GOAL 1. Conserve, enhance and restore the Texas Chenier Plain region's coastal wetlands to provide wintering, migrational, and nesting/brood-rearing habitat for waterfowl, shorebirds, marsh and wading birds, other wetland-dependent birds, and habitat for other native fish and wildlife.
- GOAL 2. Conserve, enhance and restore the Texas Chenier Plain region's coastal prairies and coastal woodlands to provide wintering, migrational, and nesting habitat for resident and migratory landbirds, including neotropical/nearctic migratory birds, and habitat for other native wildlife species.

1. Wetland Specific Management and Restoration

Managed marsh units within the Refuge Complex are under varying degrees of structural control, and may be best described as marsh semi-impoundments. Some units are entirely or almost entirely behind man-made levees and water control structures, and are intensively managed through manipulation of the water control structures. Most are managed less intensively, relying to some degree on natural topography and drainage to control hydrologic regimes.

a. Emergent Wetlands

The objective for emergent wetlands (estuarine and palustrine) is that coastal marshes and their plant communities on the Refuge Complex will be influenced only by current hydrological conditions and natural climatic events and trends. Historically, disturbance events such as wildfire, tidal and stream flooding, and herbivory by native wildlife such as snow geese and muskrats were the primary influences on marsh plant communities in the region. The habitat diversity created by these events in turn supported a diverse wetland-dependent avifaunal community.

Proposed USFWS management activities in emergent wetlands:

- Discontinue water level and salinity management on the Refuge Complex by removing water management infrastructure including levees, water delivery and drainage systems and water control structures in managed marsh units.
- Where feasible, utilize natural lightning starts to accomplish burning objectives in marsh habitats by allowing natural wildfires to burn within Refuge Complex boundaries until they naturally extinguish. Suppress natural wildfires only when they threaten refuge facilities, adjacent private property, and/or public health and safety.

- Discontinue active marsh management practices including prescribed burning, controlled grazing, and exotic/invasive plant species control. Remove grazing program infrastructure including interior fences and water developments.

b. Freshwater Prairie Wetlands (Palustrine)

The objective for prairie wetlands is to maintain shallow freshwater prairie wetlands on the Refuge Complex subject to natural climatic cycles and other natural processes. Historically, depressional freshwater wetlands dispersed throughout the region's coastal tallgrass prairie helped support a diverse avifaunal community. Ecological processes and function and plant and animal diversity within these habitats were influenced primarily by climatological events and trends.

Proposed USFWS management activities for prairie wetlands:

- Discontinue current habitat management and restoration activities on the Refuge Complex including moist soil management, rice farming and restoration of shallow freshwater wetlands.
- Allow the acreage of shallow freshwater prairie wetland habitat on the Refuge Complex to be dependent solely upon natural precipitation cycles.

2. Upland Specific Management and Restoration

a. Native Prairie and other Grasslands

The objective for native prairie and other grassland habitat is to allow natural successional changes and disturbance events to influence plant communities in the 5,744 acres of grassland habitats on the Refuge Complex, including "prairie remnants", permanently fallowed former croplands which are naturally revegetating, and sites previously restored to native prairie using intensive restoration techniques. Additional fallowed rice fields would be created under this Alternative with the discontinuation of the cooperative rice farming program on Anahuac NWR. Topography, soils, fire and grazing and trampling actions of herbivores, all in association with climate, are natural functions controlling grassland development (Ryan 1990). Fires in upland prairie prior to human occupation of the continent were started by lightning storms, primarily in mid-summer (Komarek 1964, Bragg 1982, Higgins 1984, Garbrey *et al.* 1999). Natural lightning starts continue to occur periodically in upland portions of the Refuge Complex. It is now estimated that 99.8% and 99.6 % of little bluestem and eastern gamma grass/switch grass prairies, respectfully, have been lost in Texas (McFarland 1995). Nine of the 13 avian species listed as Rare and Declining within the Coastal Prairies Region in Texas (Texas Parks and Wildlife Department 2000) are present in grasslands on the Refuge Complex. In 2005, the USFWS listed 7 avian species occurring in prairie habitats on the Refuge Complex as Avian Species of Conservation Concern in the Gulf Prairies Bird Conservation Region.

Proposed USFWS management activities for native prairie and other grassland habitats:

- Where feasible, utilize natural lightning starts to accomplish burning objectives in prairie habitats by allowing natural wildfires to burn within Refuge Complex boundaries until they naturally extinguish. Suppress natural wildfires only when they threaten refuge facilities, adjacent private property, and/or public health and safety.
- Discontinue cooperative rice farming program on Anahuac NWR.
- Discontinue habitat management and restoration activities in prairie habitats including prescribed burning, controlled grazing, invasive species control, and restoration using intensive restoration techniques.
- Initiate a monitoring program to monitor and document plant community successional stages in the Refuge Complex' grassland habitats.

b. Coastal Woodlands

The objective for Coastal Woodlands is to allow existing woodland habitats on the Refuge Complex to be influenced only by natural events such as wildfires and climatic conditions and trends. Coastal woodlots

in the Chenier Plain region are extremely important to migrating songbirds, providing essential feeding and resting areas for numerous neo-tropical migratory birds crossing the Gulf of Mexico (Rappole 1974, Sprunt 1975, Mueller 1981).

Although comprising less than 1% of Refuge Complex acreage, woodland habitats are extremely important to overall avian diversity, including several sensitive species. Six of the 7 avian species listed as Rare and Declining within the Coastal Prairies Region in Texas (Texas Parks and Wildlife Department 2000) are present in Refuge Complex woodlands. In 2005, the USFWS listed 4 species that occur in Refuge Complex woodlands as Avian Species of Conservation Concern in the Gulf Prairies Bird Conservation Region. The amount of native coastal woodlot habitat in the Chenier Plain region has been reduced mainly through development, conversion to pasture and logging of bottomland hardwoods (Mueller 1981). Although woody habitat has significantly increased in the region with the rapid expansion of exotic Chinese tallow trees, these new tallow tree woodlands provide poor habitat for migrant songbirds (Barrow 2001).

Proposed USFW management activities for coastal woodlands:

- Where feasible, allow natural lightning starts within Refuge Complex boundaries to burn, including in woodland habitats, until they naturally extinguish. Suppress natural wildfires only when they threaten refuge facilities, adjacent private property, and/or public health and safety.
- Initiate a monitoring program to document plant successional changes in existing woodland habitats and monitor and document trends in the area coverage of woodland habitat utilizing GIS technology.

B. USFWS Biological Program – Surveys, Monitoring, and Research

USFWS habitat management and restoration activities benefit many species of native fish, wildlife and plants on the Refuge Complex. The USFWS biological program on the Refuge Complex includes monitoring, field surveys and research studies of fish and wildlife population status, population trends and habitat utilization. The information obtained allows the USFWS to adapt management efforts on the Refuge Complex as needed to achieve Refuge purposes and to maintain and restore natural biological diversity and ecological integrity. Data are also used in support of international, national and regional conservation initiatives. Under this Alternative, current biological program activities which focus primarily on monitoring status and trends of waterfowl and other migratory bird populations would continue.

These wildlife conservation efforts focus on achieving the following Refuge goal:

- GOAL 3. A comprehensive biological program will guide and support conservation efforts for all species of native fish, wildlife and plants on the Texas Chenier Plain Refuge Complex.

1. Waterfowl, Shorebirds and other Wetland-dependent Migratory Birds

The biological program objective for waterfowl, shorebirds and other wetland-dependent migratory birds is to help maintain healthy populations and document population status and trends and habitat utilization of priority species utilizing the Refuge Complex. Coastal habitats of the Texas Chenier Plain region provide important wintering and migrating habitat for waterfowl of the Central Flyway, and for millions of shorebirds, wading birds, colonial nesting waterbirds, and other wetland-dependent migratory birds. Monitoring and studies of population trends and habitat utilization provide information to assess management activities on the Refuge Complex. Data are also used in support of international, national and regional migratory bird conservation initiatives.

No Change in biological program activities in Refuge Management Alternative A.

The objective for Mottled Ducks is to maintain favorable habitat conditions for the year-round needs of the Mottled Duck on the Refuge Complex, including nesting, brood-rearing, molting and wintering habitats. Under this Alternative, habitats used by Mottled Ducks on the Refuge Complex will be influenced only by natural events such as wildfires and wildlife herbivory and not by specific habitat management activities.

Historically, disturbance events such as wildfire, tidal and stream flooding, and herbivory by native wildlife such as snow geese, muskrats, and bison were the primary influences on marsh and prairie plant communities in the region. The habitat diversity created by these events in turn supported a diverse wetland-dependent avifaunal community, including habitat for the resident waterfowl species, the Mottled Duck.

Current USFWS biological program activities supporting conservation of Mottled Ducks in Refuge Management Alternative A would continue. Proposed changes in USFWS management activities for habitats used by Mottled Ducks include:

- Discontinue habitat management directed towards maintaining and enhancing habitats for Mottled Ducks, including water level and salinity management, prescribed burning, controlled grazing, and brush control.

2. Migratory and Resident Landbirds

The biological program objective for migratory and resident landbirds is to help maintain healthy populations and document population trends, status and habitat utilization of priority species on the Refuge Complex.

No Change from biological program activities in Refuge Management Alternative A.

3. Fish and other Aquatic Species

The biological program objective for fish and other aquatic species is to document population trends, status and habitat utilization of priority species on the Refuge Complex.

*No Change from biological program activities in Refuge Management Alternative A.
Water management infrastructure would be removed in estuarine marshes under this Alternative.*

4. Threatened and Endangered Species, Species of Conservation Concern

The biological program objective for Threatened and Endangered species, Species of Conservation Concern, and other “watch species” is to support recovery efforts and to obtain information on population trends, status and habitat utilization of sensitive and/or declining species utilizing the Refuge Complex. Eight federally-listed Threatened and Endangered species occur on or adjacent to the Refuge Complex: Bald Eagle, Piping Plover, Brown Pelican, Loggerhead sea turtle, Kemp’s Ridley sea turtle, Green sea turtle, Hawksbill sea turtle, and Leatherback sea turtle.

No Change from biological program activities in Refuge Management Alternative A.

5. Mammals

The biological program objective for mammals is to document population trends, status and habitat utilization of priority species on the Refuge Complex.

No change from biological program activities in Refuge Management Alternative A.

6. Reptiles and Amphibians

The biological program objective for reptiles and amphibians is to document species occurrence and monitor population status and trends. The objective for alligators is to monitor population status and trends.

Current USFWS biological program activities supporting conservation of reptiles and amphibians in Refuge Management Alternative A would continue. A proposed change in biological program activities for alligators includes:

- Discontinue the alligator harvest program on Anahuac and McFaddin NWRs.

7. Invertebrates

The biological program objective for invertebrates is to document species occurrence on the Refuge Complex.

No change from biological program activities in Refuge Management Alternative A

8. Plant Resources

The biological program objective for plant resources is to document native species composition and plant community changes over time on the Refuge Complex.

No change from biological program activities in Refuge Management Alternative A.

C. Addressing Threats to the Ecosystem

The USFWS has ongoing efforts on the Refuge Complex to address threats to ecosystem health posed by coastal land loss, hydrological alterations, exotic species, and contaminants. These include coordination with other agencies and conservation organizations on ongoing planning processes and studies aimed at developing solutions to address coastal land loss due to erosion along the Gulf of Mexico; and to implement erosion abatement projects along the Gulf of Mexico, Galveston Bay, and the Gulf Intra-Coastal Waterway (GIWW). Under Refuge Management Alternative E, efforts to address threats to ecosystem health would focus on monitoring rather than active restoration or protection.

These efforts addressing threats to ecosystem health focus on achieving the following refuge goal:

- GOAL 4. By working with others locally and on a landscape level, threats to biological integrity, biological diversity and environmental health on the Texas Chenier Plain Refuge Complex will be addressed.

1. Coastal Land Loss

The objective for the threat from relative sea level rise and reduced sediment supply is to decrease rates of coastal land loss due to shoreline erosion along the Gulf of Mexico, East Galveston Bay, and the GIWW. Along the Texas Coast, wetland losses between the mid-1950's and mid-1990's were most substantial for estuarine emergent marshes (Moulton *et al.* 1997). Relative sea level rise and reduced coarse sediment supply to Gulf and bay nearshore littoral systems are resulting in significant loss of coastal habitats. Average rates of shoreline retreat along the Gulf adjacent to the refuges are as high as 50 feet per year on Texas Point NWR, and 10-15 feet per year along most of McFaddin NWR (Bureau of Economic Geology unpublished data, Morton 1998). Over 800 acres of dunes and emergent marsh has been lost due to Gulf shoreline erosion on these refuges during the last 25 years, and remaining inland marshes are increasingly threatened by more frequent inundation during high tidal events. Although less severe, erosion along the East Galveston Bay shoreline is also causing wetland loss on Anahuac NWR, and also threatens remaining marshes with saltwater intrusion. Erosion along the GIWW is also causing direct loss of wetlands and poses a significant threat to marshes from saltwater intrusion on both McFaddin and Anahuac NWRs. Levees created when the GIWW was constructed have almost entirely eroded away along significant portions of its length within these refuges.

Proposed USFWS activities to address threats from relative sea level rise and reduced sediment supply:

- Monitor shoreline changes and land loss rates on the Refuge Complex using Geographic Information Systems and remote sensing technologies.

2. Altered Hydrologic Processes

The objective for the threat from altered hydrologic processes is to, within 15 years, document rates of emergent marsh loss (conversion of emergent marsh to open water) on the Refuge Complex. Land subsidence, sea level rise, channel construction, and channelization of natural waterways have all had significant hydrologic impacts including saltwater intrusion, tidal scouring causing erosion of organic marsh substrates, loss of freshwater inflows and excessive flooding of marshes. Over the last century, these factors have gradually converted extensive areas of fresh and intermediate marshes to a more brackish regime thereby decreasing natural biological diversity. Relative sea level rise further threatens vegetated marshes through increased saltwater intrusion and submergence. To survive, remaining marshes must accrete or gain elevation at a rate that keeps up with sea level rise. Maintaining plant productivity and preventing loss of organic marsh soils by restricting saltwater intrusion and tidal energies, increasing freshwater inflows, and beneficially using dredge materials to raise marsh elevations appear to offer the most realistic options for reversing current trends of interior marsh loss in the Chenier Plain region.

Proposed USFWS activities to address threats from altered hydrologic processes:

- Monitor status and trends of Refuge Complex wetlands using Geographic Information System and remote sensing technologies.

3. Invasive Species

The objective for the threat from invasive species is to document occurrence and distribution of invasive species on the Refuge Complex. Monocultures of invasive plants reduce natural biological diversity, increase erosion, alter nutrient cycling and displace macro- and micro-fauna that depend on native plants for habitat and food (Sheley and Petroff. 1999). Refuge habitats are currently significantly impacted by exotic plants and animals including: Chinese tallow (*Sapium sebiferum*), water hyacinth (*Eichhornia crassipes*), alligator weed (*Alternanthera ohiloceroides*), water lettuce (*Pistia stratiotes*), McCartney rose (*Rosa bracteata*), vasey grass (*Paspalum urvillei*), Johnson grass (*Sorghum halepense*), *Cyperus entrianus*, Eurasian water milfoil (*Myriophyllum spicatum*), hydrilla (*Hydrilla verticillata*), *Salvinia minima*, Japanese honeysuckle (*Lonicera japonica*) red imported fire ants, nutria, and feral hogs. Giant salvinia (*S. molesta*), to date documented on the Refuge Complex only once and in small amounts near a refuge boat ramp, has been found nearby and poses a significant threat to freshwater wetlands. Invasive native plant species include eastern baccharis (*Baccharis halimifolia*), big-leaf sumpweed (*Iva frutescens*), rattlebox (*Sesbania drummondii*), common reed (*Phragmites communis*) and cattail (*Typha* spp.).

Proposed USFWS activities to address threats from exotic and invasive species:

- Utilize Geographic Information Systems technology and a field monitoring program to identify, survey and map existing and new stands of upland and aquatic invasive plants on the Refuge Complex.

4. Contaminants

The objective for the threat from contaminants is to document direct impacts to fish and wildlife and habitats on the Refuge Complex from oil and petrochemical spills and other contaminant sources. Contaminant issues affecting the Refuge Complex include potential petroleum and petrochemical spills from: 1) on-Refuge oilfield operations; 2) shipping on the GIWW; and 3) offshore production in the Gulf. The potential for petrochemical and petroleum spills affecting the Refuge Complex is high. Over 20 active oil and gas wells are currently producing on the Refuge Complex. Significant drilling and production activity occurs in Gulf waters offshore of McFaddin and Texas Point NWRs. The GIWW between Houston and Lake Charles, Louisiana is one of the busiest reaches of this waterway for shipping petrochemical and petroleum products. The GIWW parallels much of McFaddin and Anahuac NWRs, and the Sabine-Neches Ship Channel parallels Texas Point NWR. Former and current oil and gas production areas on the Refuge Complex contain extensive infrastructure which is no longer in use, including flow lines, pipelines, oil pits, well pads, and brine disposal areas. Many of these lines, pits, and pads may contain contaminants including heavy metals, normal occurring radio-active material, brine, and

petroleum products. In addition, Refuge Complex marshes comprise the downstream end of at least 10 waterways. Factories, refineries, solid waste disposal sites, oil field sludge disposal areas, feedlot operations, agricultural operations and housing developments are potential pollution sources in upstream reaches of these watersheds. Finally, high levels of lead shotgun pellets likely occur over much of the Refuge Complex. Incidence of lead shot in waterfowl gizzards reached all time high levels during the 1990's, even after implementation of non-toxic ammunition regulations.

Proposed USFWS activities to address threats from contaminants:

- Investigate, document and report all incidences of fish and wildlife mortalities resulting from contaminant impacts including oil and petrochemical spills, lead poisoning, and disease outbreaks which may be related to contaminants affecting air, soil and water quality.

D. USFWS Public Use Program

The Texas Chenier Plain Refuge Complex offers a wide variety of recreational opportunities and received over 172,000 visitors during Fiscal Year 2002. Through the use of existing programs and facilities, the Refuge Complex provides opportunities for all six of the Refuge System's priority wildlife-dependent recreational uses, which are:

- Hunting
- Fishing
- Wildlife Observation and Photography
- Environmental Education and Interpretation

Under Refuge Management Alternative E, the Refuge Complex would continue to provide opportunities for all six of the National Wildlife Refuge System's priority wildlife-dependent recreational uses, but administrative oversight and management would occur at reduced levels.

These visitor and recreational opportunities focus on achieving the following Refuge goal:

- GOAL 5. All local, national and international visitors will enjoy safe and high quality outdoor experiences on the Refuge Complex, and learn of the Refuge Complex' role in conserving the region's coastal natural resources. New partnerships with our local communities will be forged to highlight, promote and conserve the unique natural assets of the upper Texas Gulf Coast

1. Hunting

The objective for hunting is to provide safe and high quality waterfowl hunting opportunities on the Refuge Complex. Waterfowl hunting is a traditional and still very popular outdoor recreational pursuit in the region. Refuges and other public lands along the Gulf Coast play a key role in providing hunting opportunity to the public at large.

Current USFWS public use program activities in support of hunting in Refuge Management Alternative A would continue, with the following administrative change:

- Waterfowl hunting on all hunt units will be administered on a first-come, first-serve basis, with no fee permit and no reservation and/or drawing required.

2. Fishing

The objective for fishing is to provide safe and high quality fishing opportunities on the Refuge Complex. The Refuge Complex offers exceptional recreational fishing and crabbing opportunities in both saltwater and freshwater environments. Catfish, bass and brim in freshwater environments and speckled trout, flounder and red drum in saltwater environments are among the popular game fish on the refuges. Crabbing for blue crabs is also a popular recreational pursuit along refuge waterway and lake shorelines.

No change from public use program activities in support of fishing in Refuge Management Alternative A.

3. Wildlife Observation and Photography

The objective for wildlife observation and photography is to provide safe and high quality opportunities for wildlife observation and photography on the Refuge Complex. The Refuge Complex provides local, regional, national and international visitors with a wide range of wildlife observation and photography opportunities, supporting a rapidly growing nature tourism industry in Texas. Migratory bird and alligator viewing are the main attractions. The refuges are highlighted Upper Texas Gulf Coast sites on the Great Texas Birding Trail. Anahuac NWR is an internationally known birding destination, receiving visitors each year from all 50 states and over 20 countries.

No change from public use program activities in support of wildlife observation and photography in Refuge Management Alternative A.

4. Environmental Education and Interpretation

The objective for environmental education and interpretation is to provide safe and high quality opportunities for environmental education and interpretation on the Refuge Complex. The implementation of environmental education and interpretive programs for students and visitors on the Refuge Complex is important to increase the quality of the visitor experience and to further public awareness of the benefits, issues and challenges associated with natural resource conservation in this productive and diverse coastal ecosystem.

Current USFWS public use program activities in support of environmental education and interpretation hunting in Refuge Management Alternative A would continue, with the following administrative change:

- Discontinue staff-led guided tours and education programs.
- Discontinue refuge-hosted special events and participation in local and regional festivals.

5. Beach Uses on McFaddin NWR

The objective for beach uses on McFaddin NWR is to protect public safety and natural resources along the Gulf of Mexico shoreline within the refuge. The beaches along the Gulf of Mexico on and adjacent to the McFaddin NWR support recreational uses including surf fishing, swimming, sunbathing, wildlife observation, and camping.

No Changes from current USFWS public use program activities to protect public safety and natural resources on McFaddin NWR under Refuge Management Alternative A.

E. Community Outreach and Partnerships

The objective for Community Outreach and Partnerships is to promote conservation of natural resources by working effectively with partners in support of USFWS management programs on the Refuge Complex including habitat management and restoration, fish and wildlife population management, and providing public recreational and educational opportunities. Partnerships with the Friends of Anahuac Refuge and the McFaddin and Texas Point Refuges Alliance, two citizen support groups, and with conservation organizations such as the Galveston Bay Foundation and local Audubon Society chapters have been particularly effective. Volunteers on the Refuge Complex currently provide over 10,000 hours of service annually.

Under this Alternative, the USFWS would discontinue working with private landowners on habitat restoration and enhancement projects. Current community outreach and partnership efforts would continue, but at reduced levels.

F. Administration and Staffing

Implementing Refuge Management Alternative E would involve downsizing the Refuge Complex staff by 12 full-time positions.